DEVELOPMENT OF A RELIABILITY AND MAINTAINABILITY ANALYSIS TECHNIQUE FOR HELICOPTER RESEARCH AND DEVELOPMENT

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13. ABSTRACT

A program was conducted to develop analysis techniques that would facilitate the tasks of (1) estimating the impact of predicted component reliability and maintainability (R&M) on an aircraft system in an Army operating environment and (2) evaluating and ranking competing component concepts on the basis of their R&M characteristics.

The contract effort included origination of algorithms that prepare R&M data for Army helicopter operations and maintenance (O&M) simulation, preparation of an O&M simulation model to investigate component impact in an Army environment, and preparation of a specialized life-cycle-costing approach for ranking competing component configurations on the basis of their relative cost impact (considering directly related component costs and changes in aircraft/system costs attributable to component R&M characteristics).

As a demonstration exercise, the Navy UH-1N was used to establish a data baseline for a late-model, twin-engine utility helicopter. The algorithms developed included an approach for adjusting Navy and Marine experience with the helicopter to reflect Army O&M concepts. Alternate design configurations for the main rotor blade were used to illustrate the application of the component evaluation and ranking techniques.

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U. S. ARMY AIR MOBILITY RESEARCH & DEVELOPMENT LABORATORY
EUSTIS DIRECTORATE
FORT EUSTIS, VIRGINIA 23604

This report, which was prepared by ARINC Research Corporation and RAIL Company (subcontractor) under the terms of Contract DAAJ02-72-C-0090, describes an analysis technique for estimating the impact of predicted component reliability and maintainability (R&M) parameters on an aircraft system and for evaluating and ranking competing components on the basis of their R&M characteristics. It consists of: (1) the algorithms necessary to reduce source maintenance data to the format required for GPSS (General Purpose Simulation System) R&M simulation modeling, (2) a description of the R&M probabilistic simulation model as applied to the UH-1N helicopter (software documentation submitted separately), and (3) a procedure for relative ranking of competing components on the basis of their R&M characteristics.

The conclusions contained herein are concurred in by this Directorate. This concurrence does not imply the general applicability of the UH-1N simulation baseline to other analyses without consideration of the modeling assumptions contained in this report.

The technical monitor for this contract was Mr. Robert L. Walker, Military Operations Technology Division, Eustis Directorate.

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DEVELOPMENT OF A RELIABILITY AND MAINTAINABILITY ANALYSIS TECHNIQUE FOR HELICOPTER RESEARCH AND DEVELOPMENT

Final Report

ARINC Research Corporation Report
0E19-01-1-1217

By

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SUMMARY

A program was conducted to develop analysis techniques that would facilitate the tasks of (1) estimating the impact of predicted component reliability and maintainability (R and M) on an aircraft system in an Army operating environment and (2) evaluating and ranking competing component concepts on the basis of their R and M characteristics.

The contract effort included origination of algorithms that prepare R and M data for Army helicopter operations and maintenance (O and M) simulation, preparation of an O and M simulation model to investigate component impact in an Army environment, and preparation of a specialized life-cycle-costing approach for ranking competing component configurations on the basis of their relative cost impact (considering directly related component costs and changes in aircraft/system costs attributable to component R and M characteristics).

As a demonstration exercise, the Navy UH-1N was used to establish a data baseline for a late-model, twin-engine utility helicopter. The algorithms developed included an approach for adjusting Navy and Marine experience with the helicopter to reflect Army O and M concepts. Alternate design configurations for the main rotor blade were used to illustrate the application of the component evaluation and ranking techniques.

The analysis technique developed can be applied (in full or in part) to support many management aspects of research and development programs. It is recommended that users familiarize themselves with the report material and associated computer software to facilitate adaptation of all or portions of the technique to specific program requirements.

FOREWORD

This program to develop a component-reliability-and-maintainability analysis technique for helicopter research and development was performed under Contract DAAJ02-72-C-0090, Task 1F162205A11907, with the Eustis Directorate, U.S. Army Air Mobility Research and Development Laboratory, Fort Eustis, Virginia. Mr. Robert Walker of the Military Operations Technology Division served as the Contracting Officer's Technical Representative and made significant contributions throughout the program. Messrs. Howard Bratt and Royce Prather and Major Robert Mangum of the Military Operations Technology Division also provided valuable assistance and guidance during various phases of the effort.

A major portion of the program, adaptation of a Navy aircraft operations and maintenance (O and M) simulation model to an Army aircraft O and M scenario, was performed by the RAIL Company, Incorporated, Towson, Maryland, acting as a subcontractor to ARINC Research Corporation. Mr. Henry Huffman, Jr., was Project Engineer for the RAIL Company major contributions were also made by Mr. William Friese.

The author also wishes to acknowledge the support provided by Mrs. Alice Forry and Messrs. Ben Cohen, Herbert Dagen, Donald Ingerman, Edwin Russell, and Stephen Zaccari of the ARINC Research technical staff during the course of the program.

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A1	Baseline aircraft availability
A2	Aircraft availability with an alternate component
AUR	Aircraft utilization rate, hours per aircraft per year
b	Subscript denoting baseline version of component
c	Subscript denoting component
C1	Man-hour cost at Organizational level, dollars per hour
C2	Man-hour cost at Direct Support level
C3	Man-hour cost at General Support level
C4	Man-hour cost at Depot level
C5	Transportation cost (one-way) between Organizational and Direct Support levels, dollars per component shipment
C6	Transportation cost (one-way) between Direct Support and General Support levels
C7	Transportation cost (one-way) between General Support and Depot levels
C8	Cost of parts or materials used in component repair at Organizational level, dollars per action
C9	Cost of parts or materials used in component repair at Direct Support level, dollars per action
C10	Cost of parts or materials used in component repair at General Support level, dollars per action
C11	Cost of parts or materials used in component repair at Depot level, dollars per action
C12	Cost of parts or materials used in component removal and replacement action at Organizational level, dollars per action
C13	Estimated new-aircraft cost with alternate component, dollars per aircraft
C14	Estimated new-aircraft cost with baseline component, dollars per aircraft
C15	Estimated cost of alternate component
C16	Cost of baseline component
C17	Estimated salvage value of alternate or baseline component
C18	Estimated research, development, test, and evaluation (RDTE) cost for alternate or baseline component (unfactored for development risk), dollars
C19	Estimated nonrecurring investment cost associated with a component on the basis of support for five aircraft, dollars per five aircraft
C20	Shipping container cost associated with one spare component, dollars per spare component (e.g., if containers are required for spares on a one-for-one basis, use total estimated cost of one container; if containers are required on the basis of one for every two spares, use half of total estimated cost of one container, etc.)
CD	Year in life cycle that component (RDTE) is to be completed, number of life-cycle year

CO	Year in life cycle that component operation is to be completed (same as aircraft), number of life-cycle year
CP	Year in life cycle that component procurement is to be completed (initial procurement of components for installation and sparing to fill pipelines — not replenishment for scrapped components — normally coincident with aircraft procurement completion), number of life-cycle year
DMC	Depot-maintenance cost associated with maintenance-personnel expenditures and parts or component consumption
DR	Discount rate applied to adjust later costs to "Present Value"
ECI	Effective cost influence in discounted differential dollars
FDR	Flying days in a life-cycle year, days per year
FHR	Fleet flying hours per day
HR1	Direct maintenance man-hour expenditure rate on the component at the Organizational level (including Integrated Direct Support Maintenance, IDSM) — all actions, i.e., check-out, repair, or removal and replacement of installed component and off-equipment repair/check serviceability of removed component at IDSM, man-hours per flying hour
HR2	Direct maintenance-man-hour expenditure rate on the component at the Direct Support level, man-hours per flying hour
HR3	Direct maintenance-man-hour expenditure rate on the component at the General Support level, man-hours per flying hour
HR4	Direct maintenance-man-hour expenditure rate on the component at the Depot level, man-hours per flying hour
i	Subscript denoting i^{th} version of alternate component
IN	Nonrecurring investment cost
IR	Recurring investment cost
k	Subscript denoting life-cycle year
LCC	Life-cycle cost
LCFH	Fleet life-cycle flying hours
MP1	Mean manpower required for on-aircraft component repair, average number of men over mean elapsed maintenance time (MEMT)
MP2	Mean manpower required for component removal and replacement actions, average men over MEMT
MP31	Mean manpower required for off-equipment component actions at the Organizational (IDSM) level, average men over MEMT
MP32	Mean manpower required for off-equipment component actions at the Direct Support level, average men over MEMT
MP33	Mean manpower required for off-equipment component actions at the General Support level, average men over MEMT
MP34	Mean manpower required for off-equipment component actions at the Depot level, average men over MEMT
MPC	Maintenance personnel cost
MR1	Maintenance-action rate involving the installed component (repair or remove and replace) at the Organizational level, actions per flying hour

MR2	Maintenance-action rate on the component at the Direct Support level, actions per flying hour
MR3	Maintenance-action rate on the component at the General Support level, actions per flying hour
MR4	Maintenance-action rate on the component at the Depot level, actions per flying hour
MT1	Mean elapsed maintenance time (MEMT) for component on-equipment repair, actions per flying hour
MT2	MEMT for component removal and replacement actions, hours
MT31	MEMT for component off-equipment actions at the Organizational level, hours
MT32	MEMT for component off-equipment actions at the Direct Support level, hours
MT33	MEMT for component off-equipment actions at the General Support level, hours
MT34	MEMT for component off-equipment actions at the Depot level, hours
NSC1	Mean number of spare components to fill the logistics pipelines
NSC2	Number of spare components to provide a desired probability of having a spare available when required (PS)
OC	Operating cost
P1	Probability of component maintenance action requiring removal
P2	Probability of component condemnation at Organizational level given removal
P3	Probability of component condemnation at Direct Support level given that component was received from Organizational level
P4	Probability of component condemnation at General Support level given that component was received from Direct Support
P5	Probability of component condemnation at Depot level given that component was received from General Support
P6	Probability of component shipment from Organizational to Direct Support level given removal
P7	Probability of component shipment from Direct Support to General Support level given that component was received in Direct Support
P8	Probability of component shipment from General Support to Depot level given that component was received in General Support
P9	Probability of component's having been removed to facilitate other maintenance given removal
P10	Probability of installed or removed component repair at Organizational level given a requirement for maintenance
P11	Probability of component repair at Direct Support level given that component was received in Direct Support
P12	Probability of component repair at General Support level given that component was received in General Support
P13	Probability of component repair at Depot level given that component was received in Depot
P14	Probability of component being lost to the field; that is, condemnation or shipment to Depot by General Support given a removal and replacement action (NRTS 1-9)

P15	Probability of component shipment to Depot by General Support given a removal and replacement action (NRTS 1-8)
P16	Probability of component condemnation at Depot given condemnation action
P17	Probability of component condemnation given removal and replacement action (NRTS 9 plus subsequent condemnations at Depot of NRTS 1-8 components)
PCC	Parts or component consumption cost
PDS	Probability of component-development-program success (RDTE risk)
PS	Probability of having a spare component immediately available when one is required
Q1	Quantity of a particular component installed per aircraft
Q2	Estimated total fleet size of new aircraft or system procurement
RD	RDTE cost factored for risks associated with development success
s	Subscript denoting system/aircraft
s-c	Subscript denoting aircraft less component
SD	Year in life cycle that component RDTE is started, number of life-cycle year (i.e., SD = 1)
SO	Year in life cycle that component operation is to be started (same as system/aircraft), number of life-cycle year
SP	Year in life cycle that component procurement is to start, number of life-cycle year
T1	Mean elapsed repair-pipeline time on a removed component at the Organizational level (IDSM), days
T2	Mean elapsed repair-pipeline time on a removed component at the Direct Support level, days
T3	Mean elapsed repair-pipeline time on a removed component at the General Support level, days
T4	Mean elapsed repair-pipeline time on a removed component at the Depot level, days
T5	Mean elapsed shipping-pipeline time on a removed component from Organizational to Direct Support level (one-way), days
T6	Mean elapsed shipping-pipeline time on a removed component from Direct Support to General Support level (one-way), days
T7	Mean elapsed shipping-pipeline time on a removed component from General Support to Depot level (one-way), days
T8	Mean elapsed component resupply time from placement of Government order to receipt of new components at the Depot (maintenance/supply) from the manufacturer, days
TC	Component transportation cost
YD	Number of life-cycle years that component is in RDTE, years
YO	Number of life-cycle years that component is in operation (same as aircraft), years
YP	Number of life-cycle years that component is in procurement (installed components and spares to fill logistics pipeline; normally procurement time is same as that of associated aircraft), years
*	Symbol signifying multiplication when used in mathematical formulas

INTRODUCTION

BACKGROUND

During the formulation and conduct of development programs for new Army aircraft and aircraft components, candidate design configurations often must be considered and an approach selected for continued development. Selections may depend on various combinations of criteria. For example, component performance is a basic criterion: if acceptable performance cannot be demonstrated by analysis or test, or both, development will not be continued. Development risk is also an important consideration: if candidate configurations are at different stages with respect to the state of the art, estimates of the probability of development success are important in terms of schedule and cost. The impact of the reliability and maintainability (R and M) characteristics of candidate components on system operation and cost is also a significant criterion, and it is often difficult to estimate.

OBJECTIVES

The program reported on herein involved the development of techniques that would facilitate estimating the impact of predicted component R and M characteristics and ranking candidate components on the basis of their relative desirability. These techniques were to include the following:

- Development of algorithms for defining a helicopter in terms of aircraft, system, and component R and M indices.
- Development of a computer model (1) to simulate helicopter unit operations and maintenance (0 and M) in an Army scenario and (2) to support evaluation of the impact of alternate component R and M characteristics, maintenance approaches, and a variety of other O and M factors on system/aircraft and unit operational readiness, aircraft availability, on- and off-equipment maintenance man-hour expenditures, etc.
- Development of an approach to relative ranking of competing component configurations on the basis of their R and M characteristics.

APPROACH

The following tasks were performed to accomplish the program objective:

- Aircraft operating and maintenance-support factors that could be influenced by component R and M characteristics were reviewed, and an evaluation was made of their possible impact on evaluation and relative ranking of competing components.
- Army utility-helicopter operating and maintenance (O and M) concepts were studied, and in-depth interviews were held with experienced Eustis Directorate personnel and field personnel of the 119th Assault Helicopter Company (269th Aviation Battalion), the 517th TC Aircraft Direct Support Company (189th Maintenance Battalion), and the Aircraft General Support activity — all of the XVIII Airborne Corps — at Fort Bragg, North Carolina, to ensure a good understanding of current and anticipated practices.

- The Navy UH-1N was selected to establish a data base for use during demonstration of the component-analysis and -ranking techniques under development. The factors in this selection were the planned use of aircraft O and M simulation in the program, with the concomitant requirement for historical data on a complete helicopter system, and the Eustis Directorate's desire to use a late-model, twin-engine utility helicopter.
- On the basis of the selection of the Navy UH-1N and the planned use of the Navy 3-M system to extract historical data, in-depth interviews were held with personnel of the Rotary Wing Branch at Naval Air Systems Command; the Air Weapons Branch at Headquarters, Marine Corps; and the Helicopter Marine Light 167 Squadron and Headquarters & Maintenance Squadron (Intermediate Maintenance Activity) of Marine Air Group 29 at New River Marine Air Station, Jacksonville, North Carolina. The purpose of these interviews was to improve our understanding and interpretation of the O and M concepts that influenced available UH-1N data.
- A technique was developed for R and M analysis and comparative ranking of competing components. This technique involves a cost model designed specifically for consideration of the effects of component R and M in an overall aircraft O and M environment. The cost model is designed to use aircraft availability (A) as well as component R and M, cost, and logistics information developed through analysis of the components under consideration.
- An Army helicopter O and M simulation model was developed for use in establishing aircraft RMA baseline indices. Information obtained during investigation of Army O and M concepts was used to provide guidance in model development. The new model, prepared in General Purpose Simulation System (GPSS) language, is derived from the VALUE IV model currently in use by the Navy. In addition to its application in this program, the simulation model can be applied in various trade-off investigations that might be of future interest to the Eustis Directorate.
- Algorithms were developed to process raw helicopter component data on the Navy UH-1N from the 3-M system into component R and M input, in GPSS format, for the simulation model. The algorithms included techniques for modifying the R and M input to compensate for the fact that the baseline data represented an O and M scenario different from that being simulated, so that the final simulation-model input reflected Army O and M concepts. Information obtained during the investigation of Army and Navy/Marine helicopter O and M concepts was used extensively during development of the data-modification techniques. A point is provided for in the algorithm at which the Navy 3-M data being processed lose identity, as such, and become essentially non-service-oriented. It is at this point (in magnetic-tape-data format) in the algorithm, just preceding calculation of the GPSS R and M input functions, that data from any source (Army, Navy, or Air Force) would have to be processed in order to apply the function calculation and following portions of the algorithm to other aircraft or source-data systems.
- Finally, the overall component R and M analysis and ranking technique was demonstrated by processing raw data on the UH-1N into aircraft system and component input functions that reflected Army concepts of maintenance, and then simulating a selected Army O and M scenario. Data were incorporated to input alternate configurations of main rotor blades previously under study by the Army, and parametric simulations were run. Simulation-model output was studied, along with other data sources on the alternate main rotor blades, and input data were prepared for application in the cost model. The cost model was exercised, and relative ranking of the alternate main-rotor-blade configurations was established.

The basic tasks described above — component-relative-ranking-technique development, Army O and M simulation-model development, simulation-model R and M input-data development, and component-evaluation and -ranking exercise — are discussed in detail in the following sections of this report. The report is supplemented by separate submittal of simulation-model and input-data-algorithm software, including program/job card decks, program and sample input/output listings, program symbol definitions, etc. The software is designed for operation on the COTE 1200 terminal at the Eustis Directorate, which is connected to the IBM 360/65 computer facility located at the U.S. Army Aviation Systems Command in St. Louis, Missouri.

COMPONENT-RELATIVE-RANKING TECHNIQUE

A life-cycle-costing (LCC) technique was developed in the program for the evaluation and ranking of competing component concepts on the basis of their reliability and maintainability (R and M) characteristics. The cost model is programmed and can be exercised on the Eustis Directorate's COPE 1200 terminal, which is connected to the AVSCOM 360/65 facility.

The life-cycle-costing technique was selected for component ranking since it provided a usable common denominator – dollars, or "units of value" - for combining the various areas of consideration influenced by component R and M (without resorting to the approach of "weighting factors" assignment, which is often very difficult to justify quantitatively).

The impact of LCC in the analysis of competing systems and components is that its use will sometimes lead to a conclusion in the cost area that differs from the one that would be reached if consideration were limited to initial costs. In other words, the "downstream", or consequential, effects of R and M are weighted along with initial costs. LCC comparisons of competing components are, of course, only one factor in the overall management decision since it may be determined that certain benefits available from a competing system or component, such as additional performance, justify extra cost.

The LCC technique developed was tailored specifically to meet the objective of the program — to assist in the evaluation and ranking of competing component concepts.

All life-cycle analyses, unless they are accomplished after the fact with "complete" records, involve estimates of many factors and should not be looked upon as definitive predictions of total life costs; that is, there is considerable risk in translating LCC estimates into budget requirements. The benefits of LCC analyses, therefore, lie primarily in the comparative consideration of "like" items. On this basis, and because of the Eustis Directorate's desire for simplification of the ranking technique to the extent practical, LCC factors that can reasonably be considered equivalent between competing components have been identified and eliminated.

For example, LCC that could accrue to a component because of inactive downtime — for repair parts, maintenance people, or shipment — should not be chargeable to a component competing on the basis of its R and M characteristics. This is true at least where relative component ranking is determined early in research and development programs, when proper manning, timely ordering of parts, etc., are considered reasonable assumptions. Also, Government in-house costs for component RDTE program management, integrated-logistics-system management, and other management-related efforts would not tend to vary as a function of component selection. These aspects of LCC, and others, that have been eliminated to establish a simplified and reasonable basis for comparing alternate components are described at appropriate points in the discussion of the technique developed.

DEVELOPMENT OF COST CATEGORIES INFLUENCED BY COMPONENT R AND M

The Army, in AR 37-18, sets forth the basic life-cycle cost equation as follows:

Life-Cycle Cost (LCC) = Research and Development Cost (RD) + Investment Nonrecurring (IN) + Investment Recurring (IR) + Operating Cost (OC)

where RD = Cost of design and development through prototypes

IN = Investment costs related to initiating production and introduction of an item that are not necessarily tied to unit costs or subsequent procurement

IR = Engineering, manufacturing, and other costs that are reflected in unit costs of procurements

OC = Costs associated with operating and maintaining delivered production units

In each category, the Army makes a further basic subdivision into contractor and in-house Government costs. As stated previously, many of the in-house costs related to such aspects as component RD program management, Government facilities, complete system testing, procurement management, system operating crews, etc., are not considered, because of either their minimal pertinence or their probable equivalency in a comparative analysis and ranking of competing components. Thus many of these in-house expenses related to a helicopter system will remain essentially unaffected by individual component decisions. Certain in-house component-induced costs such as maintenance and transportation (as related to component logistics support) are, of course, considered along with Government expenditures to contractors.

To arrive at a simpler ranking approach, it is desirable to segment the Army's LCC expression so that costs influenced by component R and M characteristics can be reasonably grouped. To accomplish this, the LCC of a system (LCC_S) can be viewed as consisting of the LCC's of its individual and independent components (LCC_C).

When a given system component is considered, the LCC expression can then be written

$$LCC_S = LCC_C + LCC_{S-C}$$

or, the life-cycle cost of the system equals the life-cycle cost of the component plus the life-cycle cost of the system less the component. Further,

$$LCC_S = (RD + IN + IR + OC)_C + (RD + IN + IR + OC)_{S-C}$$

There is, however, at least one interdependent relationship between the two terms in the above expression that can be important in an analysis of component R and M characteristics. That is the influence of component characteristics on aircraft availability or operational readiness. Since our interests in this program lie in the comparative analysis of the R and M influence of components functioning in a given aircraft O and M environment on the basis of their inherent design characteristics, determining a component's influence on system "intrinsic" availability has more significance than other types of readiness determinations. (Intrinsic availability does not consider the non-work or waiting portions of downtime associated with such times as administrative free time or processing time, awaiting maintenance personnel or equipment, or awaiting replacement parts.)

In the technique developed for considering an alternate component's influence on system availability, it is assumed that the availability of the baseline aircraft has been determined to be adequate for supporting a given mission requirement and that if this availability were increased

or decreased, the "number" of systems procured could be increased or decreased accordingly. Stated differently, given the mission flying-hour requirement for Army utility helicopters and knowing the availability of a baseline utility helicopter, one can determine the number of baseline aircraft needed to satisfy the flying-hour requirement. The cost associated with procurement of this number of helicopters is represented by the system recurring investment cost, IR_S.

The availability of the baseline system is a function of the R and M characteristics of all the system's components. If a component is replaced by one with different R and M characteristics, availability is expected to change (with the change being minimal or significant, and positive or negative, depending on the component's overall influence). Any such change in availability would theoretically result in a need for fewer or additional aircraft to satisfy the given mission flying-hour requirement, depending on the direction of change. The change in numbers would concomitantly bring about an increase in recurring investment cost, ΔIR_S.

The equation for LCC_S could then be rewritten as follows:

$$LCC_S = (RD + IN + OC)_{S-C} + (IR_S + \Delta IR_S^{\dagger}) + (RD + IN + OC)_C$$

or

$$LCC_S = (RD + IN + OC)_{S-C} + (IR_{S-C} + \Delta IR_{S-C} + IR_C) + (RD + IN + OC)_C$$

By eliminating the terms in the above expression that are related solely to the baseline system, and should be equivalent in a comparative ranking of components, we can write an expression for a life-cycle-cost estimate related to each component that can be used in subsequent ranking:

$$LCC_C = \Delta IR_{S-C} + IR_C + RD_C + IN_C + OC_C$$

The first term, ΔIR_{S-C}, represents consideration of the effect that changing from the baseline system component to a candidate component would have on system-less-component recurring investment costs as a result of the alternate component's influence on system availability (which in turn could influence the number of systems procured). This influence could be positive or negative, as indicated previously.

The second term, IR_C, represents the recurring investment costs related to the candidate component, including the cost of components installed in delivered systems, spare components procured to fill estimated in-work and transportation pipelines, and initial stockage covering the estimated depot-manufacturer reorder cycle (with some level of safety, if desired). Recurring costs associated with component replenishments, to offset consumption, are included in operating costs.

The last three terms -- RD_C, IN_C, and OC_C -- address costs directly related to a candidate component in the categories indicated.

Each of these terms, which is calculated for each candidate component, is expanded in subsequent paragraphs.

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† ΔIR_S would equal zero when the system included only baseline components.

The analysis technique generally proceeds as follows: Cost terms are calculated for each component and are associated with years in the estimated life cycle. Differential costs are determined between candidate components for each cost term and year. Yearly differential costs are factored (on the basis of the "present value" concept of discounting) to reflect the influence of time on anticipated future expenditures, and then totaled to obtain a measure of life-cycle effective cost influence (ECI_C). The ECI_C for each candidate component is used for relative ranking, the component with the lowest ECI_C being ranked first etc. These computational procedures are outlined more fully, and examples are given, as the technique developed is reviewed in greater detail.

The approaches used for determining each LCC_C term are described in the following subsections.

Effect on System (Less Component) Recurring Investment (ΔIR_{S-C})

The mean annual ΔIR_{S-C} is based on the following:

$$\Delta IR_{S-ci_k} = \frac{\begin{array}{l}\text{[Total procurement cost of systems with an alternate component, less procurement cost of the installed alternate components] minus} \\ \text{[Total procurement cost of systems with the baseline component, less procurement cost of the installed baseline components]}\end{array}}{\text{Number of aircraft procurement years}}, \quad k = SP, SP+1, \ldots, CP$$

The mathematical expression for ΔIR_{S-ci_k} reduces to the following:

$$\Delta IR_{S-ci_k} = \frac{\left[\frac{A1}{A2} * Q2 * (C13 - Q1 * C15)\right] - \left[Q2 * (C14 - Q1 * C16)\right]}{YP}, \quad k = SP, SP+1, \ldots, CP$$

The availabilities, A1 and A2, used in the above expression can be calculated in a variety of ways. However, as noted previously, calculations of "intrinsic" availability are most meaningful since the program is directed toward supporting R & D program efforts in evaluation of inherent component R and M characteristics owing to hardware design, installation features, and operating stresses. Thus operations and maintenance-scheduling decisions, repair-parts or maintenance-personnel shortages, and other factors that can cause large fluctuations in down-time, uptime, free time, and administrative time should be subordinated to the basic hardware parameters of time-in-operation versus time-in-repair.

The use of a simulation model to determine aircraft availabilities in support of the analysis technique makes it possible to consider the probability of multiple/concurrent corrective maintenance actions on components and the fact that certain maintenance actions required on components can be deferred until a scheduled maintenance event. In the case of the Army, these scheduled events are aircraft intermediate and periodic preventive maintenance (PMI and PMP).

With this simulation capability, the typical approach to calculation of intrinsic availability can be described as follows:

$$A = \frac{\dfrac{\text{Flying Hours}}{\text{Total unscheduled and PMI and PMP downing events}}}{\dfrac{\text{Flying Hours}}{\text{Total unscheduled and PMI and PMP downing events}} + \dfrac{\text{Total elapsed active downtime for unscheduled and PMI and PMP maintenance}}{\text{Total unscheduled and PMI and PMP downing events}}}$$

or

$$A = \frac{MFHBDE_{Sched + Unsched}}{MFHBDE_{Sched + Unsched} + MEMT_{Sched + Unsched}}$$

A similar calculation can be made with only unscheduled maintenance being considered; however, the above calculation is believed to be most appropriate because deferred corrective maintenance is frequently performed during PMI and PMP and because the purpose of performing the PMI's and PMP's is to exert a positive influence on the time between unscheduled component-maintenance actions.

NOTE: In the application of the simulation and cost models developed in this program, there will be instances in which the simulation to determine aircraft availabilities, with baseline and alternate components, will not be sensitive enough to detect the effect of changing one component, or even a few, particularly when the failure rates and maintenance expenditures on those components are relatively low in comparison with the balance of the system. In this situation (which occurred in the exercise conducted in this program), instead of using simulation results to determine A1 and A2 inputs for the cost model, the investigator has the option of assuming no significant difference in A1 and A2 (thus making $\Delta IR_{S\text{-}cik} = 0$) or proceeding on an analytical basis by simulating to determine a steady-state A1 and using that value and known baseline and alternate-component mean R and M data to determine A2's arithmetically. This latter approach, which assumes independence of the component(s) under evaluation, is described further in the component-ranking exercise for the main rotor blade.

Component Recurring Investment Cost (IR_C)

As indicated previously, IR_C includes the cost of components installed in delivered systems and the initial procurement of spares to satisfy pipeline requirements.

The mean annual IR_C is based on the following:

$$IR_{ci_k} = \frac{\text{[Total cost of installed components to cover in-work pipelines at Organizational (O), Direct Support (DS), General Support (GS), and Depot (D) levels of maintenance] + [Total cost of spare components to cover in-transit (or reorder) pipelines between O and DS, DS and GS, GS and D, and D and manufacturer]}}{\text{Number of component initial-procurement years (not resupply)}}, \quad k=SP, SP+1, \ldots, CP$$

The mathematical expression for the mean annual IR_{ci_k} reduces to the following:

$$IR_{ci_k} = \frac{C15}{YP}\left\{\frac{A1}{A2} * Q1 * Q2 + \left(1 + \frac{C20}{C15}\right) * NSC2\right\}, \quad k=SP, SP+1, \ldots, CP$$

where NSC2 is defined in the expression for the Poisson distribution,

$$\sum_{x=0}^{NSC2} \frac{(NSC1)^x e^{-NSC1}}{x!} = PS$$

and NSC1, the mean number of spare components required to fill the logistics pipelines, is defined by the expression

$$\begin{aligned} NSC1 = FHR\{ & MR1*P1\,[(1-(P2+P6+P9))*T1 + 2*P6*T5 \\ & + P2*(T5+T6+T7+T8)] \\ & + MR2*[P11*T2 + 2*P7*T6 + P3*(T6+T7+T8)] \\ & + MR3*[P12*T3 + 2*P8*T7 + P4*(T7+T8)] \\ & + MR4*(P13*T4 + P5*T8)\} \end{aligned}$$

A basic assumption made in the mathematical expression is that each maintenance level is injected into the repairable- and serviceable-component pipelines; that is, components move only from 0 to DS to GS to D — or any portion thereof — and the reverse.

Component Research and Development Cost (RD_C)

RD_C represents the estimated research and development costs related to a candidate component through prototype development and, in most situations, test and evaluation. Since the intention is to establish relative ranking early in, or prior to, the actual R&D phase of the component or system life cycle, the estimated R&D costs related to each candidate component should be factored by the development risk, or probability of development-program success, as a function of the magnitude of the technology achievements required in relation to the current state of the art. (Development risks related to competing components could normally be estimated by in-house Government personnel who specialize in the particular component-development area.)

The mean annual RD_C is based on the following:

$$RD_{ci_k} = \frac{\dfrac{\text{Contractor estimate of R\&D cost}}{\text{Government estimate of the probability of development success}}}{\text{Number of development years}}, \quad k=SD, SD+1, \ldots, CD$$

The mathematical expression for the mean annual RD_{ci_k} reduces to the following:

$$RD_{ci_k} = \frac{C18}{PDS*YD}, \quad k=SD, SD+1, \ldots, CD$$

Component Nonrecurring Investment Cost (IN_C)

IN_C includes the costs associated with placing a component in operational service that are not reflected in unit-cost procurements of the component. This term may be viewed as a "catch all" under which costs related to special facilities, tooling, training, technical data, special support equipment, etc., might be considered. Only those aspects that differ significantly between the candidate components and the others should be given consideration. Further, aspects not specifically related to component R and M might also be ignored, if desired, to maintain emphasis on R and M characteristics in the ranking process.

As with the other cost categories, mean annual IN_C associated with each component would be segmented into life-cycle year(s) of applicability (normally coincident with procurement years). In the programmed cost model, IN_C is inputted for each component configuration on the basis of cost related to the support of sets of five aircraft. (The five-aircraft base was chosen because of the approach used in Reference 1 for costing main-rotor-blade support equipment. In application, this constant can be changed in the program, with a compatible change in the input of C19, as appropriate.)

The mathematical expression for mean annual IN_{c_k} reduces to the following:

$$IN_{c_k} = \frac{\dfrac{A1}{A2} * QS * C19}{5*YP}, \quad k=SP, SP+1, \ldots, CP$$

Component Operating Cost (OC_c)

The Army, in AR 37-18, categorizes the costs associated with operation and maintenance of an item in service as follows:

- Personnel
  - Crew*
  - Maintenance
- Consumption
  - Parts
  - Petroleum, oils, and lubricants
  - Ammunition*
  - Electric power*
- Leasehold*
- Integrated Logistics Support (ILS)*
- Transportation
- Depot Maintenance

The categories annotated with an asterisk should not generally be affected by individual component R and M characteristics (ILS in this case addresses management of the logistics system). Petroleum, oils, and lubricants will also not normally be pertinent to component R and M ranking. Exceptions may occur where components, such as engines, present variations in maintainability or servicing characteristics as a result of differences in consumption rates of these items; however, because of the relatively minimal impact on R and M trade-offs, they will not be addressed.

Ranking of components on the basis of their R and M characteristics, as represented by related operating costs, will be a function of maintenance personnel, expenditures on the component (MPC_c), parts/component consumption (PCC_c), component transportation (TC_c), and component depot-maintenance costs (DMC_c), or

$$OC_{ci_k} = \frac{(MPC + PCC + TC + DMC)}{YO} \quad ci, k = SO, SO+1, \ldots, CO$$

Maintenance-Personnel Cost (MPC_c)

Maintenance-personnel cost (MPC_c) could be defined as the total cost of the personnel assigned — per applicable 0, DS, or GS Tables of Organization and Equipment (TOE) — to perform maintenance functions. In this category of operating cost, however, AR 37-18 excludes supervisory and administrative personnel and all others who are not assigned to perform the active-repair and preventive-maintenance function. In our approach to this cost category, we go slightly farther: It is not likely that personnel assignments in basic TOEs will be revised because of individual component trade-off decisions (revisions are more likely because of a significantly higher or lower total of active man-hours required to support a system consisting of an amalgamation of components); therefore, in making R and M trade-offs, we propose to consider only the active man-hours expended on the component by the direct maintenance personnel. The nonactive time associated with these personnel will not be considered.

Depot maintenance personnel are treated separately in accordance with the AR 37-18 approach.

The mean annual MPC_c is based on the following:

$$MPC_{ci_k} = \frac{\begin{array}{l}\text{[Maintenance personnel cost at Organizational level] + [Maintenance personnel cost at Direct Support level] + [Maintenance personnel cost at General Support level]}\end{array}}{\text{Number of years of component operation}}, \quad k=SO, SO+1, \ldots, CO$$

The mathematical expression for mean annual MPC_{ci_k} reduces to the following:

$$MPC_{ci_k} = \frac{LCFH}{YO} \quad (HR1*C1+HR2*C2+HR3*C3), \quad k=SO, SO+1, \ldots, CO$$

Parts-Consumption Cost (PCC_c)

For support of a basic assembly or component, such as a rotor blade, a transmission, a tail-rotor hub assembly, etc., as planned with the ranking approach, parts-consumption costs can be in two basic categories: (1) resupply of the basic component when it is condemned (beyond limits for repair) or when it is retired (having reached its assigned maximum operating life, if retirement is applicable); and (2) consumption of associated parts or materials during repair or replacement of the component. The ranking approach is developed to consider both; however, unless fairly complete data are available, actual application of the approach can be confined to the first category.

The mean annual PCC_c is based on the following:

$$PCC_{ci_k} = \frac{\begin{array}{l}\text{[Parts-consumption cost related to Organizational level] + [Parts-consumption cost related to Direct Support level] + [Parts-consumption cost related to General Support level]}\end{array}}{\text{Number of years of component operation}}, \quad k=SO, SO+1, \ldots, CO$$

The mathematical expression for mean annual PCC_{ci_k} reduces to the following:

$$PCC_{ci_k} = \frac{LCFH}{YO}\Big\{MR1*[P1*(C12 + P2*(C15 - C17)) + P10*C8] + MR2*[P3*(C15 - C17) + P11*C9] + MR3*[P4*(C15 - C17) + P12*C10]\Big\}, \quad k=SO, SO+1, \ldots, CO$$

Transportation Cost (TC_c)

Transportation costs will represent the cost of component shipment between the levels of maintenance. Components are, as previously indicated, assumed to move through each level sequentially to the authorized level of repair or to the point at which condemnation (or retirement) decisions are made and the component is scrapped.

The mean annual TC_c is based on the following:

$$TC_{ci_k} = \frac{\begin{array}{l}\text{[Transportation cost between Organizational and Direct Support levels] + [Transportation cost between Direct Support and General Support levels] + [Transportation cost between General Support and Depot levels]}\end{array}}{\text{Number of years of component operation}}, k=SO, SO+1, \ldots, CO$$

The mathematical expression for mean annual TC_{ci_k} reduces to the following:

$$TC_{ci_k} = \frac{LCFH}{YO}\{MR1*P1[2*P6*C5 + P2*(C5 + C6 + C7)] + MR2*[2*P7*C6 + P3*(C6 + C7)] + MR3*[2*P8*C7 + P4*C7]\}, k=SO, SO+1, \ldots, CO$$

Depot-Maintenance Cost (DMC_c)

Depot-maintenance costs include expenditure of direct maintenance man-hours and parts consumption in support of the component. Facilities and general depot equipment will normally not be affected by component selection. The cost of special support equipment that might be required as a function of component selection is considered in IN_c.

The mean annual DMC_c is based on the following:

$$DMC_{ci_k} = \frac{\begin{array}{l}\text{[Maintenance-personnel cost at the Depot level] + [Parts-consumption cost related to the Depot level]}\end{array}}{\text{Number of years of component operation}}, k=SO, SO+1, \ldots, CO$$

The mathematical expression for mean annual DMC_{ci_k} reduces to the following:

$$DMC_{ci_k} = \frac{LCFH}{YO}[HR4*C4 + MR4*P5*(C15 - C17) + MR4*P13*C11], k=SO, SO+1, \ldots, CO$$

COMPONENT-RANKING SUMMARY TABULATIONS

The rankings of candidate components are tabulated in sequentially developed tables such as those in Figure 1.

Annual costs estimated for each candidate component, developed from the eight cost-category expressions described previously, are entered in the appropriate life-cycle year in the Annual Cost table. Seven of these costs are associated directly with developing, producing, placing in service, and operating and maintaining the component. The eighth cost, ΔIR_{s-c}, represents the change in system-procurement costs resulting from the change in system availability because of candidate-component R and M influence. All of the costs are closely related to component R

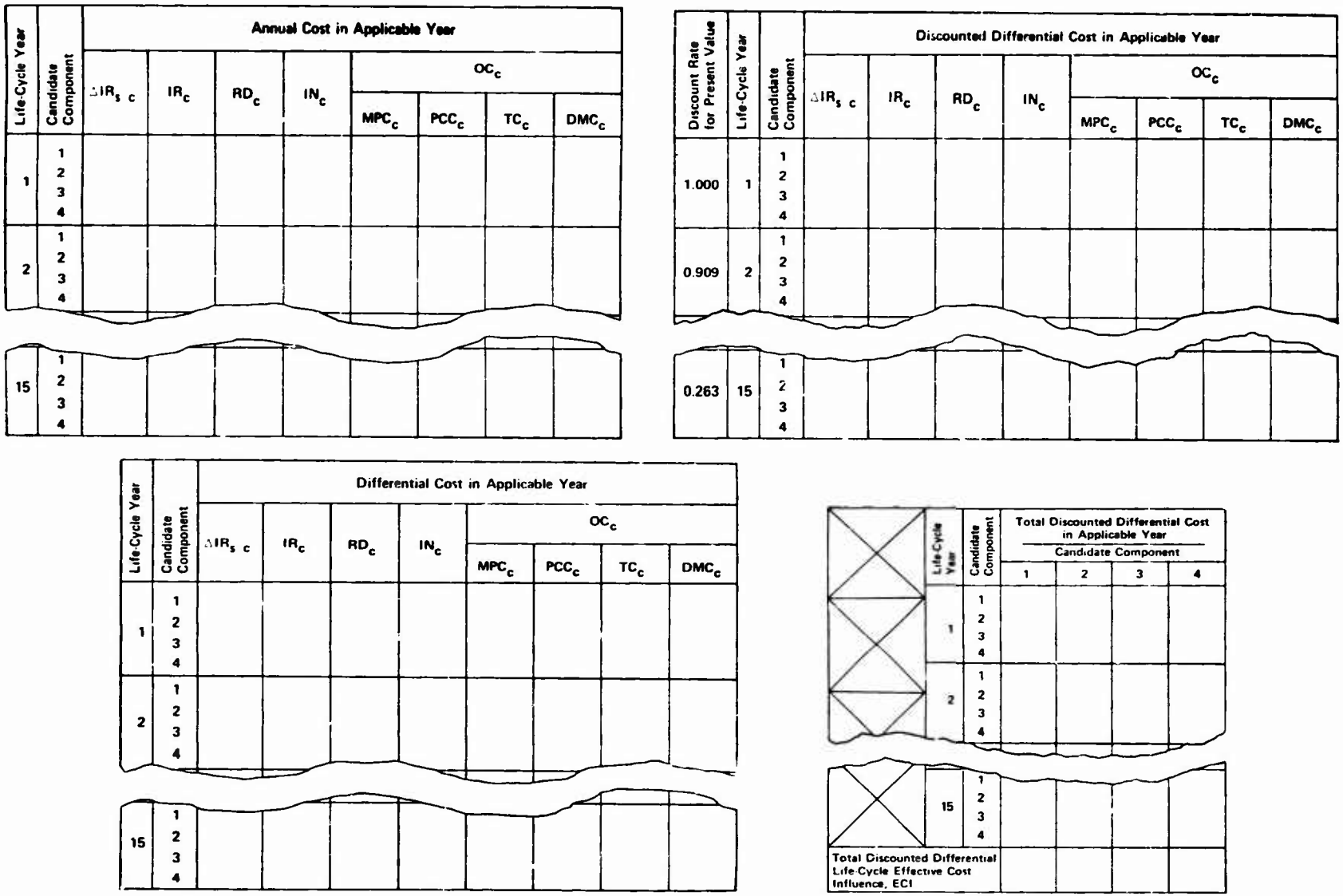


Figure 1. Ranking Tabulation Formats.

and M, except possibly certain aspects of research and development and nonrecurring and recurring investment costs.

Since "relative" ranking of the candidate components is of primary interest and numerous estimates are involved in calculating the costs for the component, any tendency to use these cost estimates as projected-budget information should be discouraged. To prevent their being used for such purposes, the calculated cost in each category and life-cycle year is reduced to a differential base by subtracting the lowest cost from each of the component-associated costs (thus reducing at least one component cost to zero) and entering the results in the Differential Cost table.

The next step involves consideration of the influence of time on the annual differential component costs. Almost all life-cycle-costing analyses developed in recent years have reflected a realization that the point at which an expenditure is anticipated must be considered, since the value of money is influenced by time, as manifested in interest costs and inflation.

A new Department of Defense document (Reference 2) discusses the subject as follows:

> ". . . time is considered in the economic or financial sense, such that later expenditures are considered 'less costly' than equal sums which could be spent sooner. Since the Government is a chronic long-term debtor, we can think of this as reduction in interest costs when expenditures are postponed . . . . the equations provided in this Guide reflect the time value of money. They are processed in the standard manner for making cost streams comparable, namely, by adjusting all costs to a common point in time. Since the common point is the present time, the processed cost is called the 'Present Value'. The processing consists of discounting each future cost, at an administratively determined rate, from the planned time of occurrence back to the present time."

The DoD document makes the following observations on the subject of inflation in the determination of "Present Value":

> "The persistent occurrence and threat of inflation in recent years generates great awareness of another way in which time can affect costs, that is, through the changing value of our unit of measurement (the dollar). The equations in this Guide do not, at this time, reflect this problem. One consideration which is often overlooked, from a decision-making point of view, is that higher (inflated) costs are paid with less valuable (deflated) dollars, and there is a considerable offsetting effect . . ."

Following selection of an interest rate to adjust costs for the time value of money (typically these rates have been in the range of 5 to 10 percent — not counting inflationary aspects, since we believe that the offsetting effect noted by DoD implies minimal impact in a comparative analysis), discount rates are calculated and annual differential costs are discounted, and the results are entered in the Discounted Differential Cost table.

The discounted costs are then subtotaled for each candidate component by life-cycle year, and yearly costs for each component are totaled to represent Total Discounted Differential Life-Cycle Effective Cost Influence, ECI, in the final ranking table.

The candidate component with the lowest ECI ranks as the most preferable on the basis of its R and M characteristics, the second lowest represents the second most preferable, etc.

In Figure 1 a 15-year life cycle and a 10-percent interest rate are shown for example only.

ARMY O AND M SIMULATION MODEL

The Army aircraft simulation model was developed under the direction of Eustis Directorate personnel to examine the capabilities and support requirements of Army aircraft. The potential of this model lies in its capability to simulate a complex operations scenario and to provide numerous output data concerning the aircraft's capability to perform in the given environment.

The model can be used with conceptual as well as operational weapons systems, thus providing an evaluation tool that can be used throughout the life of a weapons system. When used with conceptual aircraft designs, it permits an evaluation of logistics, reliability, and maintainability interfaces; it allows a measurement of the relative performance of candidate designs; and it can be used to assist in the creation of a realistic supportability plan. For aircraft designs currently under development, the model can be used to isolate critical support, reliability, and maintainability elements and to identify profitable areas of improvement; it can be used to influence the design through quantitative and sensitivity evaluations; and it can provide quantitative input data for system-effectiveness and cost models. For operational aircraft, the model can conduct contingency evaluations and can play an important role in optimizing support effectiveness.

Briefly, the model is a network of logical and mathematical functions and decisions that represent the aircraft and the support system. Each aircraft being evaluated is described in terms of systems and subsystems or components. For the sake of consistent terminology, each of these subsystems or components is referred to as an element throughout this report. For each element to be modeled, the pertinent reliability, maintainability, and supportability characteristics must be generated. These data range from mean elapsed maintenance time to accomplish each repair on each element to the percentage of time a given element will cause an airborne or ground abort. Other inputs include such factors as the types of missions to be simulated; mission priorities; number of organizational, Direct Support (DS), and General Support (GS) maintenance personnel identified by skill-type/work-center designation; the aircraft maintenance facilities available; the type of repair actions that necessitate a test flight; and frequency, elapsed time, and manpower requirements to accomplish daily, maintenance preflight, and PMI or PMP inspections.

At the conclusion of a simulation run, printouts are obtained that can be developed in a wide variety of output forms depending on the user's requirements. This provides the option of placing emphasis on the type of data desired for a particular analysis while suppressing output that is of no interest (thereby saving computer run time). The outputs range from total aircraft/system performance data — such as NORS (Not Operationally Ready, Supply) and NORM (Not Operationally Ready, Maintenance) percentages; and DMMH/FH (Direct Maintenance Man-Hours per Flying Hour) — to such items as the number of elements returned to the depot, the number of cannibalizations, and the number of maintenance-action requirements discovered during various inspections or in flight. (Undesired output data may be suppressed in the GPSS programming language by use of INCLUDE and LIST/UNLIST cards; additional options for data suppression are not built into the specific model.)

MODEL CHARACTERISTICS

GPSS/360 language employs logic, numeric, and Monte Carlo techniques and features broad logical power, reasonable computer running time, and relative ease of model construction and use. The language permits the total weapon system to be analyzed dynamically by evaluation of the capability of the weapon system and its support system to meet mission requirements.

Since the intricate complexities of the mission and support system are constructed in the model itself, only standard analysis inputs and statistics are required. Thus the exercise process is a relatively simple operation.

Considerable care was taken in the selection and development of the various model routines — the purpose being to introduce maximum flexibility and to enable growth by merely changing event parameters or incorporating minor subroutines.

A high degree of realism is employed in the logic and flow of the model. The input data (MEMT; MTBMA; maintenance personnel quantities and work-center assignments; etc.) are defined in the model at a level consistent with the user's purpose (for example, aircraft definition at the major-system level may be sufficient for a conceptual study, whereas an operational study would probably require an aircraft definition in greater detail). A reasonable number of influential perturbations and events have been logically introduced throughout the model to account for such factors as ground support equipment (GSE) delays, maintenance actions, and preventive-maintenance items (such as time-change components). Many of these events are introduced with an appropriate distribution and are subjected to Monte Carlo techniques to obtain a higher degree of realism.

MODEL CONSTRUCTION

The Army Aircraft Simulation Model consists of nine major routines that can be exercised, given proper input data, to produce the desired output statistics. The routines are described briefly below.

Mission-Generator Routine

The mission generator is the "action" routine of the model. Its purpose is to identify the operational missions to be undertaken and to initiate the selection of the aircraft and its configuration. Depending on the type of aircraft being simulated, the mission generator logically selects one or more missions for each aircraft type. The characteristics of these missions can easily be revised by changing input-data cards; a greater or lesser number of missions may be incorporated in the same manner.

For the mission identified, the routine determines the requirements for aircraft configuration, number of flights, and flight length. These mission requirements are subsequently sent to the aircraft routine for fulfillment. If the required number of aircraft are not available — for instance, too many aircraft may be down for maintenance — the mission generator will elect to call up the standby aircraft, wait until sufficient aircraft are available, or send a reduced number of aircraft on the mission. The choice of possible actions is controlled by input data to the model.

The mission generator also contains the logic necessary to limit the flying schedule to a predetermined period of the day, week, or month. Thus the flying schedule can be initiated, varied, or terminated at any time interval specified by the user, including a maximum flight schedule — that is, around-the-clock, seven-day-week operation. Provisions are also included for terminating the flying schedule when the desired flying-hour program is completed. The flying-hour program can be specified by mission type if desired.

Aircraft Routine

The Aircraft Routine controls the availability of the platoon/company aircraft for operational

missions by logically assigning the aircraft to "standby" and "downtime" activities. Within this routine the aircraft moves through preflight activities, flight, preflight/postflight, servicing, and daily inspections during the simulated period of operation. Both the Mission Generator Routine and the Unscheduled Maintenance Routine interface directly with the Aircraft Routine; aircraft availability is reduced according to mission or maintenance demands, or both; and, upon completion of these activities, the aircraft is again restored to ready availability.

Preventive-Maintenance Routine

The Preventive-Maintenance Routine constrains aircraft availability (in the aircraft routine) by imposing PMP and PMI inspections, component/element time change, and servicing, as required by the particular aircraft design being simulated. Preventive-maintenance requirements are programmed inputs to the model· they provide the timing for selecting aircraft, utilizing facilities, and expending maintenance manpower for aircraft inspection, refurbishing and servicing, check-out, and flight test. After the inspections and tests are completed, the aircraft, personnel, and facilities are made available for other operations.

Failure-Determination Routine

The Failure-Determination Routine uses a Monte Carlo technique to introduce probability-of-maintenance-action statistics into the model. Probability-of-maintenance-action data for each aircraft, system, and element to be simulated comprise the program input for this routine. As the aircraft and its equipment are utilized during the simulation period, MA (Maintenance Action) requirements are introduced as a function of event (preflight, flight, etc.), the probabilities of occurrence, and application of Monte Carlo techniques. If an MA requirement is discovered before takeoff, the Failure-Determination Routine determines if it is an "up" or "down" squawk; if it is the latter, the aircraft is removed from pre-launch activities and sent to the Unscheduled-Maintenance Routine. The Mission Generator Routine then selects another aircraft or an alternative course of action. MA requirements may also be generated after takeoff; depending on probabilistic determinations of the element or elements involved and their influences on flight completion, the aircraft will either complete the flight or abort.

Aircraft having a "down" squawk are routed to a point in the simulation where the required maintenance is assessed. It is at this point that the repair location, repair/replacement-element availability, manpower requirements, time to repair, and GSE delay are determined.

The repair location is based on decision criteria supplied by the user. If necessary, the aircraft can be subjected to relocation and an ensuing delay. (Relocation for downed aircraft is counted within the model as downtime in the NORM category.)

Having confirmed the availability of a replacement element (if required), this routine next identifies the number and type (based on work-center assignment) of maintenance personnel required to remove and replace or repair the part in place. Next, the specific time to repair is calculated by Monte Carloing the mean elapsed maintenance time (an input) against an appropriate distribution. (In this program application of the model, the exponential distribution was used to modify mean maintenance times. Any standard or nonstandard distribution may be substituted by placing the desired input in Function 36.)

The start of the repair task is influenced by a GSE-delay circuit that Monte Carlos against an input probability to determine if a delay is applicable.

Unscheduled-Maintenance Routine

As described under the Failure-Determination Routine, system and element MA's will be incurred on the basis of reliability data inputted to the model. Aircraft that experience a "down" squawk maintenance action are carried in Not Operationally Ready status and enter the Unscheduled-Maintenance Routine after leaving repair assessment. The Unscheduled-Maintenance Routine assigns the personnel and facilities to perform the necessary corrective action. If the required maintenance personnel are not available, the aircraft will be delayed until they are available. When the personnel are available, the aircraft is delayed within the Unscheduled-Maintenance Routine for a calculated time to repair, and the maintenance personnel are held unavailable for the same period of time.

Upon completion of repair, the aircraft is returned to ready status, unless a test flight is required. Aircraft requiring a test flight are not returned to a ready status until the test flight is completed. On completion of the maintenance/repair activity, support assets (personnel, equipment, and facilities) are returned to an available status.

NORS/Cannibalization Routine

The NORS/Cannibalization Routine is an amalgamation of the NORS delay logic and cannibalization logic since these two operations are closely related and interdependent — the aircraft that is "down" for parts will also be the aircraft from which parts will be taken to maintain other aircraft in the ready status. An aircraft enters this routine when it is determined that the required replacement element is not available. The first aircraft to go into this routine will be delayed until the element is available. Another aircraft entering this routine will result in the initial aircraft's being cannibalized to obtain the required replacement element. If the element is not available on the previous aircraft, the second aircraft is delayed until it becomes available. If the element is available on the previous aircraft, the second aircraft will be repaired, consuming the time and maintenance-personnel assets required to remove the element from the previous aircraft and remove and replace the one on the current aircraft. This process is repeated on all subsequent aircraft entering this routine. Since the current evaluation was made with the assumption that replacement elements were always available, this routine was not active (but was tested).

Organizational Service Platoon (Integrated Direct Support Maintenance), Direct Support, and General Support Component Repair Routine

This routine models component/element repair facilities. Elements removed from the aircraft during the course of aircraft repair are routed to this routine for disposition. Several alternatives exist: (1) the element can be repaired by the Organizational level service platoon; (2) it can be repaired by the DS level; (3) it can be repaired by the GS level ;(4) it may be NRTS (Not Repairable This Station) and sent to the depot; or (5) it may be condemned at GS. This routine controls the access to the maintenance shops and assigns appropriate maintenance personnel in accordance with inputs that specify the type of shop, MEMT, and manpower requirements for each element requiring maintenance. The MEMT is subjected to the same type of Monte Carlo technique described for the Organizational On-Aircraft repair time. The facility and personnel are held unavailable (occupied) for the duration of the computed repair time. If personnel or the facility are not available, the repair task is delayed until they are both available.

Manpower-Control Routine

The Manpower-Control Routine controls the distribution of the manpower assets in the simulation. Responding to the user's input, this routine establishes the shift lengths and controls the utilization of manpower throughout the simulation period. Control over the manpower assets is maintained at the individual shop-assignment level. This routine, in addition to establishing work intervals by shifts, can reduce, increase, or eliminate any shift or manning program during the simulation period. Thus, manning levels for reduced operations can be inputted along with levels for normal operational periods, and the model will implement the correct manpower levels at the appropriate time.

Data-Compilation Routine

The Data-Compilation Routine calculates, compiles, and tabulates the desired outputs and, at the user's option, may be set up to give printouts at any time increment, e.g., every day, week, month, etc. [The printout interval is controlled by input to MX1(5,1) in the model. Additional detail on this feature is presented in the Description of Model Internal Operations (Data Compilation Subroutine) portion of the computer software package.] The model is constructed to provide the user with "standard" outputs, i.e., items such as availability, NORS, NORM, MMH, etc., and to give him the versatility to expand the outputs depending on the type of analysis being performed. Data are collected and printed for individual aircraft and for the aggregated platoon.

MODEL OPERATION

The simplified logic diagram (Figure 2) depicts the interrelation between the major routines and some of the major functions and decisions performed by the model during the course of a simulation. The model time-base increment, at which the master clock is updated, has been set at 0.1 hour. This time increment provides the degree of output-data definition normally required for trade-off studies, parametric analyses, etc.

Briefly, the model works as follows: The Mission Generator Routine initiates the program by requesting a given number of aircraft to perform the first mission of the day. The required number of aircraft, if available, are started through a progressive set of events in preparation for the flight. These events include a daily and/or preflight inspection, as required. (Maintenance and aircrew preflight inspections were retained in the model to accommodate UH-IN 3M data input. In other Army applications, one of these preflight events can be assigned zero probability of MA occurrence to complete maintenance-concept compatibility.) Before an event is accomplished, the model interrogates the Manpower-Control Routine to ascertain the availability of the necessary personnel and equipment to perform the required event. If personnel or equipment are not available, the aircraft is placed in a queue until the required assets are available or the time-to-flight is no longer sufficient to accomplish the remaining events. The events are conducted on each appropriate aircraft system, with the allocated time being consumed in 0.1-hour increments. During these events, the status of each aircraft system is evaluated by applying a Monte Carlo reliability logic network with the system's associated, preestablished reliability data to determine the aircraft's status.

If an aircraft is found to require a maintenance action during the preflight events, it is sent to the Failure-Determination Routine for disposition. If the aircraft is subsequently found to have a "down" squawk, either it is replaced by a standby aircraft or an additional aircraft is "called up" if time permits. An aircraft found to have an "up" squawk is returned to the Aircraft Routine to complete its flight preparation, and the "up" squawk is carried over to be corrected the next time the aircraft requires maintenance or a PMI or PMP inspection occurs. In this manner, the aircraft progresses through each preestablished event and is readied for flight.

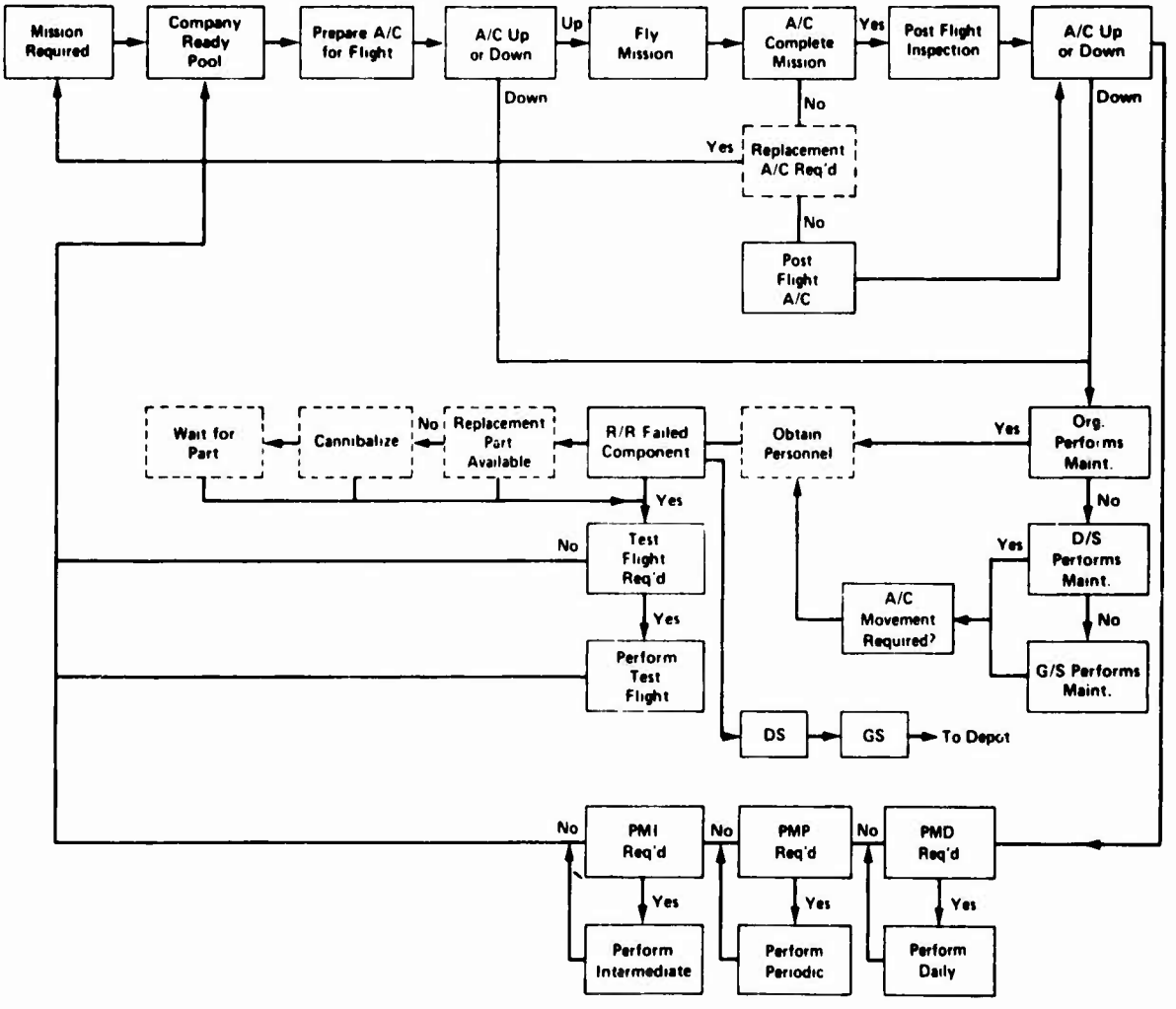


Figure 2. Simplified Logic Diagram, Army O and M Simulation.

After takeoff, each aircraft is evaluated to determine if MA's will be generated during the mission and, if so, if any of the maintenance actions will cause an abort. This determination is made by a Monte Carlo technique using a random-number generator and the reliability- and abort-data input to the model prior to the simulation. The user has the option of replacing all

airborne aborts with another aircraft, replacing none, or replacing a certain percentage. Aircraft that do not abort the mission return after consuming the required mission flight time. Maintenance actions generated during flight that did not necessitate an abort are flagged for subsequent identification during the postflight inspection.

Upon return, each aircraft is checked to determine if an in-flight MA has occurred. If a "down" squawk has occurred, the aircraft is sent to the Unscheduled-Maintenance Routine; if not, it is serviced and made ready for a rapid turnaround if necessary. The aircraft is checked to determine if a PMI or PMP inspection is due. Aircraft entering this inspection cycle are held unavailable (NORM) for the mission until the inspection and the subsequent test flight are completed. Maintenance personnel are obtained from the appropriate manpower pool to perform the inspection and are also unavailable for other duties of lower priority until their portion of the inspection is completed. Time-change items are checked and replaced (if required) during PMP inspections.

The unscheduled-maintenance cycle is entered when the Failure-Determination Routine determines that the aircraft has sustained a "down" squawk. The initial-repair-assessment section of the maintenance cycle determines whether the action required is repair-in-place or remove-and-replace, and establishes the time-to-repair, using the remove-and-replace and mean-elapsed-maintenance-time input data for that system and element in conjunction with the appropriate distribution curve and a random-number generator. If the action is remove-and-replace, the spares stock is checked to determine if the necessary repair elements are available. If they are not, and an element is not available through cannibalization, the aircraft is placed in a NORS (Not Operationally Ready, Supply) status until a spare is available. If the required elements are available, the repair location is determined on the basis of the type of MA and the predicted repair time. Before the repair is accomplished, the model has provisions for delaying the aircraft if the required GSE is not available. This feature requires that the user be able to identify a GSE-delay probability number as part of the input data. The aircraft repair is then accomplished provided the appropriate maintenance personnel, elements, and GSE are available.

Upon completion of the aircraft repair, the test-flight requirement is determined on the basis of the type of repair performed. If a test flight is required, the aircraft is prepared for flight, flies the required time, receives a postflight inspection, and is returned to the operationally ready status. Elements removed from the aircraft are routed to the appropriate maintenance facility (Organizational Service Platoon, Direct Support, or General Support) and repaired whenever shop work space and maintenance personnel are available. The component/element maintenance time-to-repair is calculated in a manner similar to that for Organizational maintenance discussed earlier in this section. Components that fail and cannot be repaired are tabulated, and these in turn generate depot-workload predictions.

INPUT DATA

The input data to the model can be broadly classified into four categories: operational, maintenance, reliability, and logistics. The major inputs of reliability and corrective-maintenance data are discussed in detail in the Simulation Model Input Functions section of this report. The other inputs required for model execution are outlined in the following paragraphs and are also further described in the Simulation Model Input Function section.

Briefly, the operational data establish the environmental, design, and mission boundaries within which the aircraft must operate; the maintenance data detail the preventive- and corrective-maintenance characteristics of the aircraft; the reliability data establish the predicted ground, airborne, and abort probabilities of the aircraft; and the logistics data define the support requirements of the aircraft. The following highlights the input data requirements by category (excluding the R and M data):

1. **Operational Data Input**

   Mission Type. Types of missions to be simulated.

   Mission Length. Mission lengths in 0.1-hour increments by type of mission.

   Mission Schedule. Flying schedule for each of the mission types, e.g., fly 2 aircraft every 3.6 hours starting at 10 p.m. and ending at 4 p.m. daily.

   Aircraft Standby Requirements. Defines the number of standby aircraft required to support each mission.

   Mission Priorities. If more than one type of mission is to be simulated, each mission type is assigned a priority to assure that missions with the greatest importance have the highest possibility of being flown.

2. **Maintenance-Data Input**

   Scheduled-Maintenance Requirements. Types, frequency, and length of all inspections, time-change components, and overhauls required.

   Maintenance-Action Priorities. Priority of the corrective and preventive maintenance tasks by category or event.

   Test-Flight Data. Repair actions that necessitate a test flight.

3. **Logistics-Data Input**

   Aircraft Maintenance Personnel. Number of maintenance personnel by work-center assignment at each maintenance echelon. In the present evaluation, no manpower limits were imposed.

   Maintenance Facilities. The types of aircraft maintenance facilities and their capabilities, i.e., type of work performed in each shop, job unit capacity, as well as an identification of the shop responsible for repairing those elements tracked by the model. In the present evaluation, no facility limitations were imposed.

   Aircraft Complement. Number of aircraft in each platoon

   NORS Probability. The probability that an element will cause a NORS delay should it fail and require replacement. Each aircraft system and element being simulated requires this probability identification. In the present evaluation, elements were assumed to be available when required.

Operating Philosophy. This category of input data covers numerous inputs that establish the basis for many of the decisions made during the simulation. Examples of this type data are:

- Aircraft are moved for repair if the maintenance task takes longer than "X" hours.
- Preparation of aircraft for flight is started "X" hours prior to flight.
- "n" aircraft will be maintained in ready alert status.

OUTPUT DATA

Outputs are available to provide statistical data on all phases of operational support. These data can be developed in a wide variety of output forms depending on the user's requirements. The model has been constructed so that a large quantity of output data is available and may be called for at the user's option. This permits the user to place the emphasis on the type of data desired for a particular analysis while suppressing the data that is not required. The depth and detail of the outputs are based on the criticality and nature of the output.

As currently configured, the model report generator provides the following data:

1. Monthly Mission Information. Missions called, missions flown, and mission flying hours are provided for each aircraft tail number and for the total platoon.

2. Monthly Scheduled-Inspection Information. The number of inspections and man-hours consumed are tabulated for each aircraft and the total platoon covering each of the following inspections: Preflight, Daily, PMI, PMP.

3. Monthly Maintenance Information. Maintenance data covering the number of maintenance actions, maintenance man-hours, and elapsed maintenance downtime are provided and separated into scheduled and unscheduled categories. Data are tabulated by aircraft tail numbers and for the total platoon.

4. Monthly Aircraft Characteristics. Direct Maintenance Man-Hours per Flying Hour. Not Operationally Ready Maintenance hours, Not Operationally Ready Supply hours, and Availability are provided for each aircraft and the overall platoon. Availability is computed in three categories: (1) Up Time/Total Time, (2) Missions Flown/Missions Called, and (3) Missions Completed/Missions Called. (Data to determine the intrinsic availability value described in the Component-Relative-Ranking Technique section are also provided in the output.)

5. Monthly Platoon Statistics. The following platoon statistics are summarized:

   - Total Flying Hours
   - Flying Hours for Completed Missions
   - Flying Hours for Aborted Missions
   - Flying Hours for Test Hops
   - Number of On-Aircraft Repairs
   - Number of Parts Removed and Replaced
   - Number of Removed Parts Repaired at the O Level
   - Number of Removed Parts Repaired at the DS Level
   - Number of Removed Parts Repaired at the GS Level
   - Number of Removed Parts Returned to Depot (NRTS)
   - Number of Removed Parts Condemned

SIMULATION MODEL INPUT FUNCTIONS

Simulation model input functions are discussed in this section. First, the equipment R and M input functions, which require computations using the historical data base, are described in detail. The input functions required to complete the operations, maintenance, and logistics scenario to be simulated are then described. Together, the two parts of the section address all of the input functions required by the simulation model.

R AND M INPUT FUNCTIONS

An input of aircraft R and M indices, including aircraft, system, and element data, to the Army O and M simulation model involves preparation of 35 GPSS-input functions.

All of these functions are prepared by using a series of computer programs and manual operations to translate Navy/Marine 3-M data into aircraft R and M input that represents operation and maintenance of the aircraft in an Army environment. Details of the overall steps involved in data processing leading to calculation of these input functions are provided in the next section of this report. In this section, the R and M input functions will be defined and the formulas used in their calculation will be presented. Table I provides definitions of the data elements and symbols used in the function equations.

Tables II, III, and IV provide supplementary definitions of the symbols used in Table I.

Aircraft-Level Functions

Preliminary calculations for aircraft-level functions must be made as follows:

a. Mean maintenance requirements discovered during preflight inspections, TMPPF

$$TMPPF = \frac{4A}{[FLTS + 7A + 8A]\left[\frac{\text{Data Flying Hours/Preflight}}{\text{Simulation Flying Hours/Preflight}}\right]} \dagger$$

†Adjustment factor that should be estimated and used if the operating and maintenance (O and M) scenario being simulated is different from the O and M conditions under which the data were generated. The factor as shown is iterative, requiring repeat simulations to estimate accurately; therefore, a reasonable approximation should be adequate. An alternate approach that provides a reasonable approximation is the ratio of data mean-flight duration to simulation flight duration.

b. Mean maintenance requirements discovered during aircrew inspections TMPAC

$$TMPAC = \frac{1A}{[FLTS + 7A]\left[\frac{\text{Data Flying Hours/Aircrew}}{\text{Simulation Flying Hours/Aircrew}}\right]} \dagger\dagger$$

††See note for TMPPF

TABLE I. DATA ELEMENTS AND SYMBOLS*

Codes	Description
	Aircraft Level, Maintenance
1A	Total aircraft A+B+E WDCs from Navy 3-M data-processing Job 9, Step 1 (field columns 12-16), i.e., aircrew-discovered
2A	Total aircraft C+D WDCs from Job 9, Step 1 (field columns 17-21), i.e., in-flight-discovered
3A	Total aircraft C WDCs from Job 9, Step 1 (field columns 22-26), i.e., in-flight/abort-discovered
4A	Total aircraft H+K+0.6R WDCs from Job 9, Step 1 (field columns 27-31), i.e., preflight-discovered totals (Note: The portion of R WDCs is included because of the practice of using QA inspectors to assist in preflight, daily, and periodic/calendar inspections during the period of data collection on the UH-1N and the erroneous practice of recording QA-discovered problems as code R instead of the appropriate type-inspection code. Apportionment was made with the assistance of the Marine users of the UH-1N when the situation was brought to their attention. With correct reporting, R code usage should become relatively insignificant, and the apportionment can continue to be used as programmed without detrimental impact.)
5A	Total aircraft J+0.3R WDCs from Job 9, Step 1 (field columns 32-36), i.e., daily-inspection-discovered
6A	Total aircraft M+N+0.1R WDCs from Job 9, Step 1 (field columns 37-41), i.e., calendar-equivalent to periodic-inspection-discovered
7A	Total aircraft A WDCs from Job 8, Step 1 (field columns 42-46), i.e., aircrew/abort-discovered
8A	Total aircraft H+K+0.6R WDCs that resulted in NOR condition of aircraft from Job 9, Step 1 (field columns 47-51), i.e., preflight-discovered and resulting in NOR condition
9A	Total aircraft Y WDCs from Job 9, Step 1 (field columns 52-56), i.e., maintenance-discovered problem with replacement item drawn from supply
10A	Total aircraft R+Q ATCs from Job 9, Step 1 (field columns 57-61), i.e., actions taken that resulted in a draw on supply
	System Level, Maintenance
1S	System totals A+B+E WDCs from Navy 3-M data-processing Job 9, Step 1 (field columns 12-16)
2S	System totals C+D WDCs from Job 9, Step 1 (field columns 17-21)
3S	System totals C WDCs from Job 9, Step 1 (field columns 22-26)

*See Navy When-Discovered and Action-Taken Codes and Work-Center Definitions in Tables II, III, and IV to assist in interpretation of code descriptions. Data-processing job references are described in the following section, Component Evaluation and Ranking Exercise.

TABLE I. (continued)	
Codes	**Description**
	System Level, Maintenance
4S	System totals H+K+0.6R WDCs from Job 9, Step 1 (field columns 27-31)
5S	System totals J+0.3R WDCs from Job 9, Step 1 (field columns 32-36)
6S	System totals M+N+0.1R WDCs from Job 9, Step 1 (field columns 37-41)
	Element Level, Maintenance
1E	Element totals A+B+E WDCs from Navy 3-M data-processing Job 9, Step 1 (field columns 12-15)
2E	Element totals C+D WDCs from Job 9, Step 1 (field columns 16-19)
3E	Element totals C WDCs from Job 9, Step 1 (field columns 20-22)
4E	Element totals H+K+0.6R WDCs from Job 9, Step 1 (field columns 23-26)
5E	Element totals J+0.3R WDCs from Job 9, Step 1 (field columns 27-30)
6E	Element totals M+N+0.1R WDCs from Job 9, Step 1 (field columns 31-34)
7E	Element totals A WDCs from Job 9, Step 1 (field columns 35-37)
8E	Element totals D WDCs from Job 9, Step 1 (field columns 38-40), i.e., in-flight/no abort-discovered
9E	Element totals D WDCs associated with NOR condition of aircraft from Job 9, Step 1 (field columns 41-43), i.e., did not cause in-flight abort but was noted in flight and aircraft went NOR upon return to base
10E	Element totals B+E WDCs from Job 9, Step 1 (field columns 44-47), i.e., aircrew-discovered, no abort
11E	Element totals B+E WDCs associated with NOR condition of aircraft from Job 9, Step 1 (field columns 48-51), i.e., did not cause aircrew abort but discovered by aircrew and associated with aircraft entering NOR condition
12E	Element totals H+K+0.6R WDCs associated with NOR condition of aircraft from Job 9, Step 1 (field columns 52-55), i.e., discovered during preflight and associated with aircraft entering NOR condition
13E	Element totals J+0.3R WDCs associated with NOR condition of aircraft from Job 9, Step 1 (field columns 56-59), i.e., discovered during daily inspection and associated with aircraft entering NOR condition
14E	Element totals 1+2+3+4+5+6+7+8 ATCs from Job 9. Step 1 (field columns 60-63), i.e., BCM from Navy (Marine) Intermediate Maintenance Activity to Depot — equivalent to Army NRTS (Not Repairable This Station) action from a General Support activity to Depot
15E	Element totals 14E (above) +9 ATCs from Job 9, Step 1 (field columns 64-67), i.e., action taken equivalent to Army NRTS from GS to Depot and condemned by GS

TABLE I. (continued)	
Codes	**Description**
	Element Level, Maintenance
16E	Element totals 15E (above) +A+B+C+D+J+K ATCs for off-equipment maintenance only from Job 9, Step 1 (field columns 68-71), i.e., all off-equipment maintenance actions count (excludes counts associated with reporting work stoppage for parts or maintenance and work in progress at the end of time period)
17E	Element totals for off-equipment Work Center 01 from Job 9, Step 1 (field columns 72-75), i.e., a count of Primary Work Center off-equipment actions on the removed element that may take place at the 0(IDSM), DS, or GS levels of maintenance
18E	Element totals for off-equipment Work Center 02 from Job 9, Step 1 (field columns 76-78)
19E	Element totals for off-equipment Work Center 03 from Job 9, Step 1 (field columns 79-81)
20E	Element totals for off-equipment Work Center 04 from Job 9, Step 1 (field columns 82-84)
21E	Element totals for off-equipment Work Center 05 from Job 9, Step 1 (field columns 85-88)
22E	Element totals for off-equipment Work Center 06 from Job 9, Step 1 (field columns 89-92)
23E	Element totals for off-equipment Work Center 07 from Job 9, Step 1 (field columns 93-95)
24E	Element totals for on-equipment Work Center 01 from Job 9, Step 1 (field columns 96-99), i.e., a count of Primary Work Center on-equipment actions on the installed element at the 0 level of maintenance
25E	Element totals for on-equipment Work Center 02 from Job 9, Step 1 (field columns 100-103)
26E	Element totals for on-equipment Work Center 03 from Job 9, Step 1 (field columns 104-107)
27E	Element totals for off-equipment man-hour expenditures from Job 9, Step 1 (field columns 108-115) — tabulation is in tenths of man-hours
28E	Element totals for off-equipment elapsed maintenance time (active clock hours) from Job 9, Step 1 (field columns 116-122) — tabulation is in tenths of hours
29E	Element totals for on-equipment man-hours expenditures for removal- and replacement-type actions from Job 9, Step 1 (field columns 123-128) — tabulation is in tenths of man-hours
30E	Element totals for on-equipment elapsed maintenance time (active clock hours) for removal- and replacement-type actions from Job 9, Step 1 (field columns 129-134) — tabulation is in tenths of hours

TABLE I. (continued)

Codes	Description
	Element Level, Maintenance
31E	Element totals $R+S+\frac{P+Q+T+U}{2}$ ATCs for on-equipment maintenance actions from Job 9, Step 1 (field columns 135-138), i.e., a count of the removal- and replacement-type actions associated with 29E and 30E in the data base
32E	Element totals for on-equipment elapsed maintenance time (active clock hours) for repair-in-place-type actions from Job 9, Step 1 (field columns 139-144) — tabulation is in tenths of hours
33E	Element totals A+B+C+D+J+K+Y+Z ATCs for on-equipment maintenance actions from Job 9, Step 1 (field columns 145-148), i.e., a count of the in-place repair-type actions associated with 32E and 34E in the data base (reported actions not reflecting a completion count, such as end-of-time-period reporting, are excluded)
34E	Element totals for on-equipment man-hour expenditures for repair-in-place-type actions from Job 9, Step 1 (field columns 149-155) — tabulation is in tenths of man-hours
35E	Element totals for R+Q ATCs from Job 9, Step 1 (field columns 156-159), i.e., actions taken that result in a draw on supply
36E	Element ratio (15E) (35E) (100)/(16E) (31E+33E) from Job 9, Step 1 (field columns 160-162), i.e., the percentage of total maintenance actions that culminated in NRTS/BCM or condemnation actions in the data base
	Aircraft Level, Operations
FLTS	Count of aircraft flights in data base (use trip count in 3-M data, as represented by Card Type 76 submittals, since trips represent departures from base whereas flight count can reflect multiple legs in a trip) from Job 7, Step 3. Trip/flight count influences preflight and aircrew inspection totals. (This count should be considered critically by the investigator and adjustments made, if appropriate, based on prior review of 3-M ASD-MDCS comparisons from Job 4 and availability of original organization reports, etc.).
AFDS	Count of aircraft flight-days in data base from Job 7, Step 3. Aircraft-flight-days count influences daily inspection totals. (This count should be considered for necessary adjustment, as with FLTS.)
CLDR	Count of aircraft calendar inspections in data base, Navy Type Maintenance Codes P+Q, from Job 7, Step 3. Navy calendar inspection count may be used to estimate equivalent number of Army periodic inspections (an alternative approach is data-base flying hours/100 hours)
FHRS	Count of flying hours in data base from Job 7, Step 3. (This count should be considered for necessary adjustment, as with FLTS. The three, FLTS, AFDS, and FHRS, should be adjusted on the same basis if adjustment is appropriate.)
SMDR	Simulation-mission duration (as selected by the investigator/Army)

TABLE II. WHEN-DISCOVERED CODES (NAVY)	
Code	**Description**
A	Before Flight — Abort — Aircrew
B	Before Flight — No Abort — Aircrew
C	In Flight — Abort
D	In Flight — No Abort
E	After Flight/Between Flights/Aircrew
H	Between Flights — Ground Crew
J	Postflight/Daily Inspection
K	Preflight Inspection
M	Calendar Odd Inspection
N	Calendar Even Inspection
R	Quality-Assurance Inspection
Y	Upon Receipt or Withdrawal from Supply

TABLE III. ACTION-TAKEN CODES (NAVY)	
Code	**Description**
1	BCM — Repair Not Authorized
2	BCM — Lack of Authorized Equipment, Tools, or Facilities
3	BCM — Lack of Technical Skills
4	BCM -- Lack of Parts
5	BCM — Shop Backlog
6	BCM — Lack of Technical Data
7	BCM — Excess to Ship/Activity Requirements
8	BCM — Budgetary Limitations
9	Condemned
A	Item/System Discrepancy Checked — No Repair Required
B	Repair and/or Replacement of Attaching Hardware
C	Repair
D	Work Stoppage — Post/Pre-Deployment
J	Calibrated — No Adjustment Required
K	Calibrated — Adjustment Required
P	Removed
Q	Installed
R	Removed and Replaced
S	Removed and Reinstalled
T	Removed for Cannibalization
U	Replaced After Cannibalization
Y	Troubleshoot
Z	Corrosion Treatment

TABLE IV. WORK-CENTER DEFINITIONS

Navy/Marine		Army	
Work-Center Code	Description	Assigned Work-Center Code	Description
On-Equipment/Aircraft Maintenance			
31X 32X 300 14X	Plane Captains/Line Work Sections Troubleshooters Line Division Calendar Inspection Crews	01	Organization (0) Level Service Platoon Maintenance Section · Periodic Maintenance · Contact Maintenance
21X 200	Electronics/COM-NAV Avionics/Weapons Division	02	Organizational Level Service Platoon Avionics Section
22X 100 11X 12X 13X Other	Electrical/Instrument Aircraft Division Power Plants Airframes Aviators Equipment	03	Organizational Level Service Platoon Shops Section · Electrical · Engine · Prop/Rotor · Machine (Welding) · Hydraulic · Tool Van
Off-Equipment (Removed Component) Maintenance			
400 41X 44X	Power Plants Division Jet Shop Rotor Dynamics Shop/Components	01	Direct Support (DS) and General Support (GS) Engine and Prop/Rotor Shops. Equivalent to 03 in 0-level Integrated Support Maintenance (IDSM) tabulation
45X	Test Cell	02	GS Test Cell equivalent
54X	Hydraulic Shop	03	DS and GS Hydraulic Shop. Equivalent to 03 in 0-level IDSM tabulation
62X	Electrical/Instrument Shop	04	DS and GS Electrical Shop. Equivalent to 03 in 0-level IDSM tabulation
600 61X	Avionics Division COMM/NAV Shop	05	DS and GS Avionics Shop. Equivalent to 02 in 0-level IDSM tabulation
500 51X 52X 55X 56X 57X Other	Airframe Division Structures Shop Machine Shop Tire Shop Welding Shop NDI Shop	06	DS and GS Sheet Metal, Machine, Welding, NDI, and other Shops. Equivalent to 03 in 0-level IDSM tabulation
53X	Paint Shop	07	DS and GS Paint Shop. Equivalent to 03 in 0-level IDSM tabulation

c. Mean maintenance requirements discovered during daily inspections, TMPD

$$TMPD = \frac{5A}{[AFDS]\left[\frac{\text{Data Flying Hours/Daily}}{\text{Simulation Flying Hours/Daily}}\right]^{\dagger}}$$

† See note for TMPPF except for the alternate-approach possibility

d. Mean maintenance requirements discovered during periodic inspections, TMPP

$$TMPP = \frac{6A}{CLDR}$$

e. Mean bad parts drawn from supply for replacement of element in aircraft, TMPBPS

$$TMBPS = \frac{9A}{10A}$$

f. Mean maintenance requirements discovered during flight, TMPIF

$$TMPIF = [2A]\left[\frac{SMDR}{FHRS}\right]$$

Function 2: Ground Event Probability of Success

This function gives the probability that an aircraft will successfully pass a given ground event. The events in the function are coded 1 — ordnance loading, 2 — preflight inspection, 5 — aircrew inspection, 11 — turnaround inspection, 16 — daily inspection, 17 — periodic inspection, and 21 — withdrawal of a part/element from supply. Success means that no requirement for maintenance (MA) was discovered during the event. The event breakdown conforms to required input format carried over from the Navy VALUE IV model from which the Army simulation was derived. Events 1 and 11 are inputted as "always successful" (six 9's) since they are not applicable in the Navy data or Army scenario. Events 2 and 5 are derived separately for convenience in the simulation; since the Army does not use an aircrew inspection, as such, the two series events are combined in the simulation-model output editor as preflight information (an alternate approach would be to input event 5 as "always successful" and merge the data in the preflight event calculation). The argument in Function 2 is the ground-event code number, and the function value (the probability of success) is a six-digit integer.

Argument	Function Value
1	999999
2	EXP (-TMPPF) * 10^6
5	EXP (-TMPAC) * 10^6
11	999999
16	EXP (-TMPD) * 10^6
17	EXP (-TMPP) * 10^6
21	EXP (-TMBPS) * 10^6

Function 3: Probability of No Maintenance Action During Flight

As with Function 2, this is the probability that no requirement for maintenance will be discovered. The argument is a number code identifying the mission. When only one mission duration is defined, the argument is a dummy zero and a one. The function value is a six-digit integer.

Argument	Function Value
0	EXP (-TMPIF) * 10^6
1	EXP (-TMPIF) * 10^6

Function 5: Probability of No Abort Given a Maintenance Action During Flight

The argument is the same as for Function 3. The function value is a six-digit integer.

Argument	Function Value
0	(1 — 3A/2A) * 10^6
1	(1 — 3A/2A) * 10^6

Function 10: Probability of Multiple Maintenance Actions Given a Maintenance Action During Flight

This function is the cumulative probability of discovering the function-value number of maintenance actions. The argument is a four-digit decimal fraction preceded by zero.

Let DENIF = 0.9999 - EXP (-TMPIF)

and x = Number of maintenance actions

Then the arguments of x are given by

$$ARG(x) = ARG(x - 1) + (TMPIF)^X (EXP[-TMPIF])/(x!) (DENIF)$$

where $x! = x^* (x - 1)^* (x - 2)^* \ldots *2*1$ and

$$ARG(1) = (TMPIF) (EXP[-TMPIF])/DENIF$$

Argument	Function Value
(TMPIF) (EXP [-TMPIF])/DENIF	1
ARG(2 - 1) + $(TMPIF)^2$ (EXP [-TMPIF])/(2!) (DENIF)	2
.	.
.	.
.	.

Function 11: Probability of Multiple Maintenance Actions Given a Maintenance Action During Preflight Inspection

This function is calculated in the same way as Function 10 — substituting TMPPF for TMPIF, letting DENPF = 0.9999 - EXP(-TMPPF), and substituting DENPF for DENIF.

Function 12: Probability of Multiple Maintenance Actions Given a Maintenance Action During Daily Inspection

This function is calculated in the same way as Function 10 — substituting TMPD for TMPIF, letting DEND = 0.999 - EXP (-TMPD), and substituting DEND for DENIF.

Function 13: Probability of Multiple Maintenance Actions Given a Maintenance Action During Aircrew Inspection

This function is calculated in the same way as Function 10 — substituting TMPAC for TMPIF, letting DENAC = 0.9999 - EXP (-TMPAC), and substituting DENAC for DENIF.

Function 14: Probability of Multiple Maintenance Actions Given a Maintenance Action During Periodic Inspection

This function is calculated in the same way as Function 10 — substituting TMPP for TMPIF, letting DENP = 0.9999 - EXP (-TMPP), and substituting DENP for DENIF.

System-Level Functions

The system-level functions are defined in the following subsections.

Function 16: Probability of a System Maintenance Action During Aircrew Inspection

This function represents a cumulative probability distribution of maintenance actions being discovered in the systems that form the aircraft, starting with the first system in the aircraft and continuing to the last. The argument is a four-digit decimal fraction, preceded by zero, reflecting the cumulative probability, and the function value is the system number, e.g., 01, 02, 03, etc. The argument must always be increasing in value to truncation at 0.9999; i.e., systems that have not experienced sufficient maintenance actions to cause a change in the argument in the fourth decimal place are omitted in the cumulative distribution series. Arguments are calculated as follows:

$$\frac{1S_{01}}{1A}, \frac{1S_{01} + 1S_{02}}{1A}, \ldots, \frac{1S_{01} \text{ thru } 1S_{\text{Last System Number}}}{1A}$$

Argument	Function Value
$1S_{01}/1A$	01
.	.
.	.
.	.
last	last

Function 17: Probability of a System Maintenance Action In Flight Given an Aircraft Maintenance Action In Flight

This function is calculated in the same way as Function 16, except that 2S is used in the numerator and 2A in the denominator for each system.

Function 18: Probability of a System-Maintenance-Action Abort In Flight Given an Aircraft Abort In Flight

This function is calculated in the same way as Function 16, except that 3S is used in the numerator and 3A in the denominator for each system.

Function 19: Probability of a System Maintenance Action During Preflight Inspection

This function is calculated in the same way as Function 16 except that 4S is used in the numerator and 4A in the denominator for each system.

Function 20: Probability of a System Maintenance Action During Daily Inspection Given an Aircraft Maintenance Action During Daily Inspection

This function is calculated in the same way as Function 16, except that 5S is used in the numerator and 5A in the denominator for each system.

Function 21: Probability of a System Maintenance Action During Periodic Inspection Given an Aircraft Maintenance Action During Periodic Inspection

This function is calculated in the same way as Function 16, except that 6S is used in the numerator and 6A in the denominator for each system.

Function 22: Number of Elements in Systems

The argument is the system numeric designation, and the function value is the number of elements in the system.

Argument	Function Value
01	Number of elements in System 01
02	Number of elements in System 02
.	.
.	.
.	.
Last	Number of elements in last system

Element-Level Functions

The element-level functions are defined in the following subsections.

Function 24: Probability of an Element Maintenance Action During Aircrew Inspection Given a System Maintenance Action During Aircrew Inspection

This function is calculated independently for each element and system in the aircraft. The argument is the system-element numeric designation, and the function value is packed with two 3-digit integers. The first pack (AP) is the function probability, with a calculated value from 000 to 999 (truncated maximum), and the second pack (BP) is blank; that is, the function value equals (AP * 10^3) + BP.

Argument	Function Value	
System ┐ ┌ Element	AP	BP
0101	$\left\{\frac{1E_{0101}}{1S_{01}}\right\} * 10^3$	ßßß
0102	$\left\{\frac{1E_{0102}}{1S_{01}}\right\} * 10^3$	ßßß
.	.	.
.	.	.
.	.	.
Last System ┘ └ Last Element		

Function 25: Probability of an Element Maintenance Action In Flight Given a System Maintenance Action In Flight

This function is calculated in the same way as Function 24, except that 2E is used in the numerator for each element and 2S in the denominator for each system.

Function 26: Probability of an Element-Maintenance-Action Abort in Flight Given a System-Maintenance-Action Abort In Flight

This function is calculated in the same way as Function 24, except that 3E is used in the numerator for each element and 3S in the denominator for each system.

Function 27: Probability of an Element Maintenance Action During Preflight Inspection Given a System Maintenance Action During Preflight Inspection

This function is calculated in the same was as Function 24, except that 4E is used in the numerator for each element and 4S in the denominator for each system.

Function 28: Probability of an Element Maintenance Action During Daily Inspection Given a System Maintenance Action During Daily Inspection

This function is calculated in the same way as Function 24, except that 5E is used in the numerator for each element and 5S in the denominator for each system.

Function 29: Probability of an Element Maintenance Action During Periodic Inspection Given a System Maintenance Action During Periodic Inspection

This function is calculated in the same way as Function 24, except that 6E is used in the numerator for each element and 6S in the denominator for each system.

Function 30: Probability of an Element Aircrew Ground Abort Given an Element Maintenance Action During Aircrew Inspection

This function is calculated for each element in a manner similar to that for Function 24, except that 7E is used in the numerator and 1E in the denominator.

Argument		Function Value		
System	Element	AP		BP
0101		$\frac{7E_{0101}}{1E_{0101}}$	$*10^3$	ϕϕϕ
0102		$\frac{7E_{0102}}{1E_{0102}}$	$*10^3$	ϕϕϕ
.		.		.
.		.		.
.		.		.

Function 32: Probability of Aircraft's Being NOR With an Element Maintenance Action In Flight Given an Element Maintenance Action No-Abort In Flight

This function is calculated independently for each element. The argument is the system-element numeric designation, and the function value is a 6-digit integer reflecting the function probability, with a calculated value from 000000 to 999999 (truncated maximum).

Argument (System | Element)	Function Value
0101	$\left(\frac{9E_{0101}}{8E_{0101}}\right) * 10^6$
0102	$\left(\frac{9E_{0102}}{9E_{0102}}\right) * 10^6$
.	.
.	.
.	.

Function 33: Probability of an Aircraft's Being NOR With an Element Maintenance Action During Aircrew Inspection Given an Element No-Abort Maintenance Action During Aircrew Inspection

This function is calculated in the same way as Function 32, except that 11E is used in the numerator and 10E in the denominator for each element.

Function 34: Probability of an Aircraft's Being NOR With an Element Maintenance Action During Preflight Inspection Given an Element Maintenance Action During Preflight Inspection

This function is calculated in the same way as Function 32, except that 12E is used in the numerator and 4E in the denominator for each element.

Function 35: Probability of an Aircraft's Being NOR With an Element Maintenance Action During Daily Inspection Given an Element Maintenance Action During Daily Inspection

This function is calculated in the same way as Function 32, except that 13E is used in the numerator and 5E in the denominator for each element.

Function 37: Percent of Element Removal and Replacement Maintenance Actions, Percent of Elements Repaired Given That Elements Were Received in General Support

This function is calculated independently for each element. The argument is the system-element numeric designation, and the function value is packed with two 3-digit integers. The first pack (AP) is the percentage of removals and replacements given a maintenance action, and the second pack (BP) is the percentage that GS repaired given that it received them. In each case the calculated value is from 000 to 999 (truncated maximum). The function value, therefore, is $(AP * 10^3) + BP$. The calculation of this function (and Function 52) includes built-in provisions for converting, or arriving at, the stated probabilities under conditions where the maintenance concept reflected in the base data differed from the concept to be simulated (as was the case in the program in which Navy 3-M data on the UH-1N were being used to represent operation and maintenance in an Army environment).

These conversion provisions require data-card input in Job 9, Step 3 that provides the following information for each element: system-element numeric designation and estimates of Army percentages for (a) removal and replacement given a maintenance action (P_1), (b) sent from Organization (Integrated Direct Support Maintenance — IDSM) to Direct Support given removal and replacement (P_2), (c) sent from DS to General Support given receipt in DS (P_3), and (d) sent from GS to Depot given receipt in GS (P_4). Logic for these conversion provisions assumes that items going to higher maintenance levels move sequentially through each; that off-equipment maintenance may (as dictated by maintenance capability) be performed at O-IDSM, DG, GS, and Depot; that all condemnations below the Depot level occur at GS; that P_1, P_2, P_3, and P_4 inputs do not consider condemnations; and that the overall maintenance capabilities below the Depot level are equivalent between the data source and the Army (i.e., NRTS/BCM and condemnation rates, as a function of element maintenance actions, are equal). On the basis of the above, the following calculations are made to adjust the estimates of Army probabilities, if necessary, to satisfy NRTS and condemnation outflow requirements from GS:

$$P_2' = 1 - \left[\frac{(1 - P_2)(P_1 - 36E)}{P_1 - (P_1 P_2 P_3 P_4)}\right]$$

$$P_3' = 1 - \left[\frac{P_2(1 - P_3)(P_1 - 36E)}{P_2(P_1 - 36E) + (36E - [P_1 P_2 P_3 P_4])}\right]$$

$$P_4' = \frac{36E}{P_1 P_2' P_3'}$$

and Functions 37 and 52 calculations are performed essentially concurrently because of a requirement for certain interdependent checks. Function 37 calculations proceed as follows for each element:

- If $P_1 \leq$ data element 36E, make Function 37 AP = 36E and Function 37 BP = 000
- If $P_1 >$ 36E and Function 52AP = $(1 - P_2') * 10^3$ = 1000/999, make Function 37 AP = P_1 and Function 37 BP = 000
- If $P_1 >$ 36E and Function 52 AP $\neq$ 999, make Function 37 AP = P_1 and Function 37 BP = $(1 - P_4') * 10^3$

Argument		Function Value	
System	Element	AP	BP
0101		000 to 999	000 to 999
.		.	.
.		.	.
.		.	.

Function 40: Skill-Code/Work-Center Designations

This function is calculated independently for each element. The argument is the system-element numeric designation, and the function value is packed with three 2-digit integers. The first pack (AP) is the code assigned to the work center that has most frequently performed off-equipment maintenance on the element. The second pack (BP) is the code assigned to the work center that has been the second most frequent performer of on-equipment maintenance on the element (considered to be the assisting work center for on-equipment maintenance in the simulation). The third pack (CP) is the code assigned to the work center that has most frequently performed on-equipment maintenance on the element (considered to be the primary work center for on-equipment maintenance in the simulation). Function 40 calculations proceed as follows:

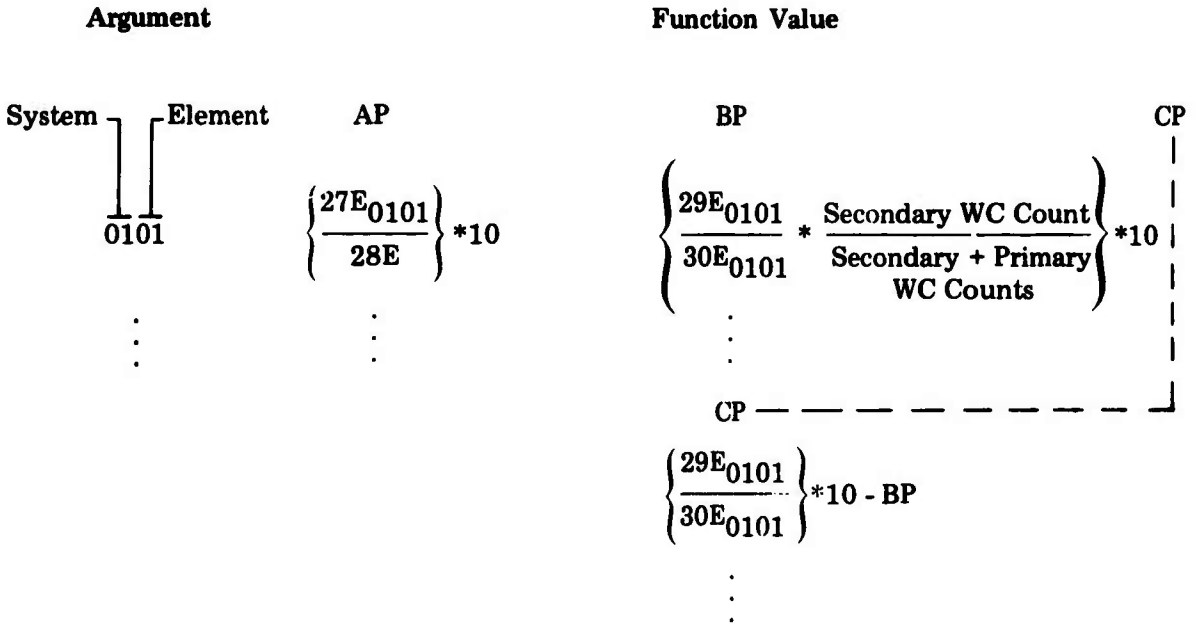
- Counts in fields coded 17E, 18E, 19E, 20E, 21E, 22E, and 23E are reviewed, and 40 AP is made equal to 01, 02, 03, 04, 05, 06, or 07 on the basis of the highest action count. In cases of ties, the first field in the sequence that ties for highest action count determines 40 AP. If all counts in 17E through 23E are equal to zero, make 40 AP = 00.
- Counts in fields coded 24E, 25E, and 26E are reviewed; 40 BP is made equal to 01, 02, or 03 on the basis of the second highest count, and 40 CP is made equal to 01, 02, or 03 on the basis of the highest count. In cases of ties for highest count, make 40 BP the highest and 40 CP the lowest number of 01, 02, and 03 (of those fields that tie). If there is only one count in 24E through 26E, make 40 BP = 00; if there are no counts in 24E through 26E, make 40 BP and 40 CP = 00.

Argument		Function Value		
System	Element	AP	BP	CP
0101		01 to 07	01 to 03	01 to 03
.		.	.	.
.		.	.	.
.		.	.	.

Function 42: Manpower for Element Off-Equipment Repair, Manpower for Secondary Work Center During Element Removal and Replacement Action, Manpower for Primary Work Center During Element Removal and Replacement Action

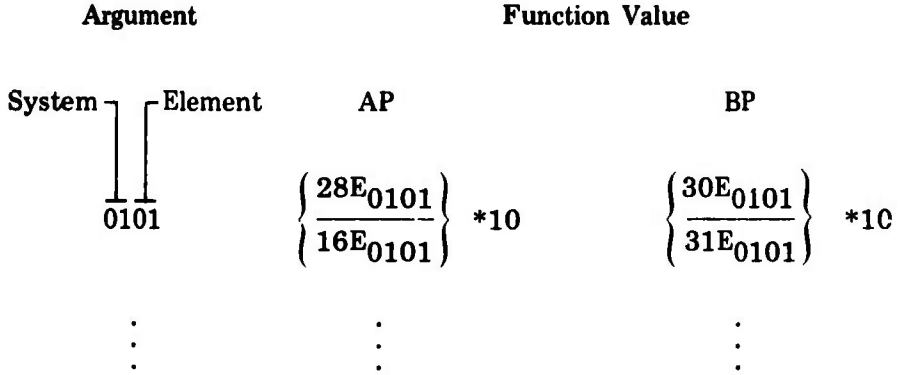
This function is calculated independently for each element. The argument is the system-element numeric designation, and the function value is packed with three 2-digit integers. The first pack (AP) represents the mean number of men, in tenths, required for element off-equipment repair. The second pack (BP) is the mean number of men, in tenths, required from the secondary work center during on-equipment element removal and replacement actions. The third pack (CP) is the mean number of men, in tenths, required from the primary work center during on-equipment element removal and replacement actions. In each case, the calculated value is from 00 to 99 (truncated maximum). The function value,

therefore, is (AP * 10^4) + (BP * 10^2) + CP. The function calculation, obtained from man-hour and elapsed-maintenance-time expenditure data (with apportionment of removal and replacement manpower between primary and secondary work centers, as determined in Function 40), proceeds as follows:



Function 43: Mean Elapsed Maintenance Time (MEMT) for Element Off-Equipment Repair, Mean Elapsed Maintenance Time for Element Removal and Replacement Actions

This function is calculated independently for each element. The argument is the system-element numeric designation, and the function value is packed with two 3-digit integers. The first pack (AP) represents the MEMT, in tenths, for element off-equipment repair (the MEMT is assumed to be applicable to all maintenance levels and types of off-equipment actions). The second pack (BP) represents the MEMT, in tenths, for on-equipment element removal and replacement-type actions, as differentiated from on-equipment/in-place repair-type actions. In each case, the calculated value is from 000 (if there were no such actions) to 999 (truncated maximum). The function value, therefore, is (AP * 10^3) + BP. The function calculation proceeds as follows:



Function 46: Elements Table Code

This function assigns a sequential numeric code to each element in the aircraft, starting with a numeric one and continuing through each system and element to the last. The argument is the system-element numeric designation, and the function value is the assigned sequential numeric code.

Argument (System–Element)	Function Value
0101	1
0102	2
.	.
.	.
.	.

Function 47: Percent of Element Not Repairable This Station (NRTS) Actions, Percent of Element NRTS or Condemned Actions

This function is calculated independently for each element. The argument is the system-element numeric designation, and the function value is packed with two 3-digit integers. The first pack (AP) is the percentage of off-equipment actions that involved NRTS of the element from GS to Depot (see discussion in Function 37). The second pack (BP) is the percentage of off-equipment actions that involved NRTS or condemnation at GS. In each case, the calculated value is from 000 to 999 (truncated maximum). The function value, therefore, is $(AP * 10^3) + BP$. The function calculation proceeds as follows:

Argument (System–Element)	Function Value: AP	Function Value: BP
0101	$\left\{\frac{14E_{0101}}{16E_{0101}}\right\} * 10^3$	$\left\{\frac{15E_{0101}}{16E_{0101}}\right\} * 10^3$
.	.	.
.	.	.
.	.	.

Function 52: Percent of Elements Repaired by Organizational Integrated Direct Support Maintenance (IDSM) Given a Removal and Replacement Action, Percent of Elements Repaired Given That Elements Were Received in Direct Support

This function is also calculated independently for each element. The argument is the system-element numeric designation, and the function value is packed with two 3-digit

integers. The first pack (AP) is the percentage of removed elements repaired at IDSM, and the second pack (BP) is the percentage of elements repaired in DS of those received from Organizational IDSM. In each case, the calculated value is from 000 to 999 (truncated maximum). The function value, therefore, is $(AP * 10^3) + BP$. The calculation of the function, described in further detail in Function 37, proceeds as follows:

- If $P_1 \leq$ 36E, make Function 52 AP = 000 and Function 52 BP = 000
- If $P_1 >$ 36E, Function 52 AP = $(1 - P'_2) * 10^3$
- If $P_1 >$ 36E and Function 52 AP = 1000/999, make Function 52 BP = 000
- If $P_1 >$ 36E and Function 52 AP $\neq$ 1000/999, Function 52 BP = $(1 - P'_3) * 10^3$

Argument		Function Value	
System	Element	AP	BP
0101		000 to 999	000 to 999
.		.	.
.		.	.
.		.	.

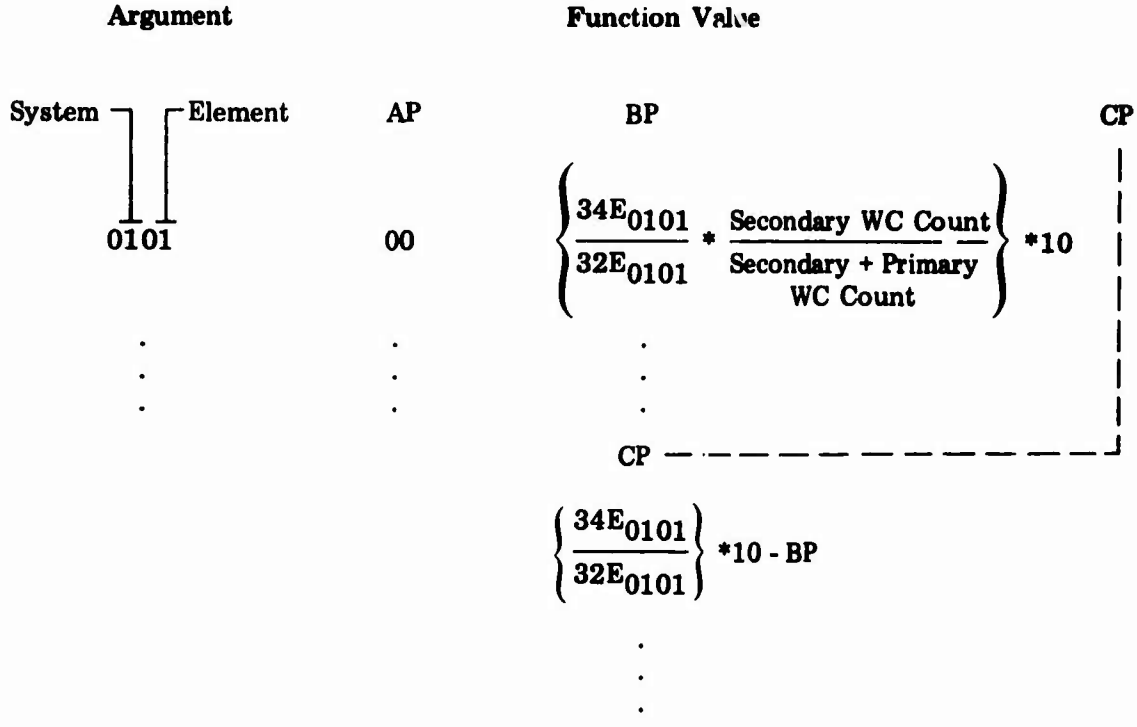
Function 53: Mean Elapsed Maintenance Time (MEMT) for Organizational Element On-Equipment Repair

This function is calculated independently for each element. The argument is the system-element numeric designation, and the function value is packed with two 3-digit integers. The first pack (AP) represents the MEMT, in tenths, for element on-equipment repair actions at the organizational level, as differentiated from on-equipment removal- and replacement-type actions. The second pack (BP) is made equal to zero, 000, for all elements. The calculated value for AP is from 000 (if there were no on-equipment repair-type actions in the data) to 999 (truncated maximum). The function value, therefore, is $(AP * 10^3) + BP$ or $(AP * 10^3) + 000$. The function calculation proceeds as follows:

Argument		Function Value	
System	Element	AP	BP
0101		$\left\{\frac{32E_{0101}}{33E_{0101}}\right\}$ *10	000
.		.	.
.		.	.
.		.	.

Function 54: Manpower for Secondary Work Center During Element On-Equipment Repair Action, Manpower for Primary Work Center During Element On-Equipment Repair Action

This function is calculated independently for each element. The argument is the system-element numeric designation, and the function value is packed with three 2-digit integers. The first pack (AP) is made equal to zero, 00, for all elements. The second pack (BP) is the mean number of men, in tenths, required from the secondary work center during on-equipment element repair actions. The third pack (CP) is the mean number of men, in tenths, required from the primary work center during on-equipment element repair actions. In each case, the BP and CP calculated value is from 00 to 99 (truncated maximum). The function value, therefore, is $(AP * 10^4) + (BP * 10^2) + CP$ or $(00 * 10^4) + (BP * 10^2) + CP$. The function calculation, performed in a manner similar to that of Function 42 (with apportionment of on-equipment repair manpower between primary and secondary work centers, as determined in Function 40), proceeds as follows:



OTHER O AND M INPUT FUNCTIONS

In addition to the R and M input functions just described, several other functions must be provided as model input.

Function 1: Reconfiguration Sort

In the present configuration only one mission type is specified and this function serves no purpose in the existing scenario. Where more than one mission is involved, this function controls which aircraft configurations can fly particular missions.

Function 4: Flight Duration

This function defines mission length. It is inputted with the X field equal to mission type and the Y field equal to mission duration in tenths of hours. For example: 0 15 1 15 means that mission 0 (Test Hop) is 15 clock units and mission 1 is 15 clock units (1.5 hours).

Function 6: Line Inspection Manpower, Work Center, and Duration

This function defines the number of men, the work center involved, and the time required to perform each type of line inspection used in the simulation. Present input defines preflight (event code 2) and daily (event code 16) requirements. Function X fields and Y fields contain event codes and 6-digit packed information, respectively. For example: 100102 is interpreted by reading—left to right—10, one man; 01, work center 01; 02, 2 clock units (12 minutes).

Function 7: Maintenance Priority

When two or more events are competing for manpower assets, this function defines the order in which they will be satisfied. Function X fields and Y fields are event codes and priorities, respectively. Priority is in natural order; i.e., 1 is the lowest-priority job.

Function 8: Queue Limit Ground Events

This function provides the capability of imposing time limits on ground events; that is to say, if the event is not accomplished in the time specified by the function, it will be canceled. The X fields contain event codes, and the Y fields contain time limits. In the model configuration used in this program, no practical time limit is specified for any event other than the load ordnance event (the load ordnance event, however, was not used in the simulation); i.e., the other events were assigned a function solution of 999999.

Function 36: Exponential Distribution

This function is used to modify mean repair times. The mean time to repair for each element is multiplied by this input to provide the repair time for a specific event. In this exercise an exponential distribution was used because previous tests with Navy 3-M repair times showed such a distribution. Other analyses may require different repair-time distributions. These different distributions may be inputted by removing the existing Function 36 and replacing it with the desired distribution.

Function 38: Probability of Part Availability

In this exercise Function 38 was not used. It was configured as a dummy input so that the required part was always available. For analyses with limited spare parts, this function would be activated by filling each X field with element numbers and each corresponding Y field with the probability of the part's being available.

Function 44: Test Hop Candidates

This function defines those aircraft elements which have the potential of requiring a test flight after the completion of unscheduled maintenance. X values are element numbers (101, 2501,

etc.), and Y values are 1 or 0. A Y value of 1 indicates a potential test flight. In its present form the function is interpreted as follows:

Element	Test Flight Required
0101-0400	No
0401-0424	Yes
0425-0503	No
0504	Yes
0505-0617	No
0618	Yes
0619-1300	No
1301	Yes
1302	No
1303	Yes
1304-2501	No

It should be noted that test-hop determination is made in two steps. First, Function 44 is interrogated to determine if the maintenance action represented by the transaction is a candidate for a test hop. When Function 44 evaluates to 1, a test hop may be required. The second step is made in the model logic by the statistical transfer block just prior to ARRH. The number in this block (0.533 for the present evaluation) represents the percentage of test-hop candidates that do require test hops. This percentage is computed as the sum of the remove-and-replace maintenance actions divided by total maintenance actions for all test-hop candidates.

Function 45: Supply Delay

In this exercise Function 45 was not used, since parts were always considered to be available. Future analyses considering supply problems would require this function to be provided as input. Element numbers are loaded into X fields. The corresponding Y field is provided with the average delay to obtain a part, given that one is not available. Y field data are in 0.1-hour clock units. For example, a 72-hour delay would be inputted as 720.

Function 48: Probability of Cannibalization

Cannibalization was not considered in this exercise, and Function 48 was therefore loaded as a dummy. In normal runs, where parts are defined at the element level, this function is still not required. Only in cases where the aircraft is defined to the "system" level is it necessary to activate this function. X values would be system numbers, and Y values would be the probability of cannibalization.

Function 49: DS and GS Shops

This exercise did not use Function 49. The purpose of Function 49 is to permit the analyst to specify shop facilities. These could be such items as engine rails, automatic test equipment, or other assets that would impose physical constraints on testing of elements at the DS or GS level.

Function 50: Not Used

Function 51: Probability of Multiple Failure, Bad Part From Supply

This function provides the capability of assuming multiple cases of receiving bad parts from supply for a single maintenance event. The normal assumption is that only one bad part can be obtained on any maintenance event. It is recommended that this function not be altered on subsequent evaluations.

Functions 9, 15, 23, 31, 39. 41, 55

These functions are sorting functions and do not require revision for revised input.

COMPONENT EVALUATION AND RANKING

Preceding sections of this report have covered the life-cycle costing technique for evaluating and ranking competing components, the O and M simulation model for determining aircraft parameters, and detailed procedures for calculating the R and M input data for the simulation model. This section presents a review of the overall procedure for analyzing competing components on the basis of their R and M characteristics.

The Navy UH-1N twin-engine utility helicopter was selected as the baseline aircraft for the program. Therefore, the receipt of 3-M data from the Navy Maintenance Support Office (MSO) at Mechanicsburg, Pennsylvania, is the starting point for the algorithm developed to process historical aircraft data for simulation-model input, to perform subsequent O and M simulation, and, finally, to complete candidate-component ranking. There is a point in the algorithm, however, where data from any source can be formatted on magnetic tape in a manner that will permit application of the balance of the algorithm. This point and the other important features of the algorithm are described in the following paragraphs.

The algorithm is described in a job sequence, with the UH-1N baseline aircraft and competing main-rotor-blade analysis being incorporated for demonstration purposes. Most of the jobs are computerized; however, there are several manual interfaces that require interpretation of data for proper direction of the computer-processing effort. In addition, portions of the algorithm involve manual computations. All of the computerized jobs have been prepared for operation on the Eustis Directorate's COPE 1200 terminal, which is connected to the IBM 360/65 OS facility at the U.S. Army Aviation Systems Command (AVSCOM) Headquarters, St. Louis, Missouri.

The algorithm can be divided into four basic parts: (1) Tabulation of Aircraft Historical Data, (2) R and M Input Function Calculations, (3) O and M Simulation, and (4) Component Relative Ranking. See Figure 3.

PART 1: TABULATION OF AIRCRAFT HISTORICAL DATA

The purpose of the first part of the algorithm is to develop formatted magnetic-tape tabulations of aircraft historical data that can be used readily to calculate the R and M input functions required by the simulation model. Nine computerized jobs are involved (jobs 1 through 8A and B), along with manual analysis and input, as described below.

Job 1, SELECT

The purpose of Job 1 is to select historical data of interest by Type Equipment Code (TEC) from Navy 3-M raw-data magnetic tape(s) that are in Navy card-type (CT) format. As shown in Figure 3, the Navy 3-M data tape is processed through Step 1, TECSEL (the only step in Job 1), and two tapes are generated: tape AHDTTO1, the data of interest; and tape AHDTTO2, data related to other TECs that may have been on the 3-M tape(s). The investigator can use the program in Job 1 to separate data that he may have requested for other or later efforts, or the program may only serve the necessary purpose of eliminating unwanted or erroneously supplied data from further processing.

In the demonstration effort, the end-item TECs AHAP for the UH-1N aircraft and TSAB for its associated T400-CP-400 engine were selected for inclusion on tape AHDTTO1.

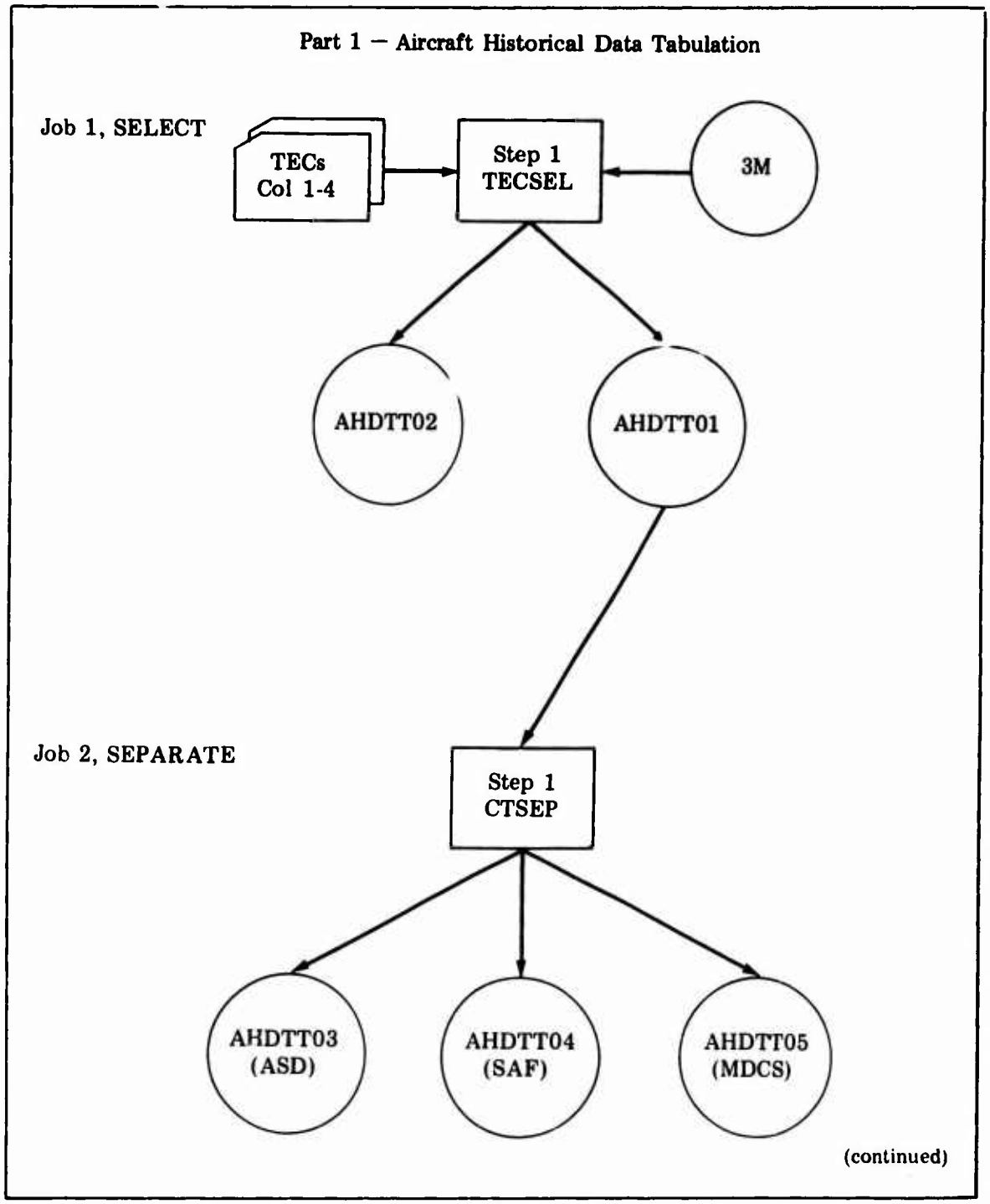


Figure 3. Component Evaluation and Ranking Algorithm.

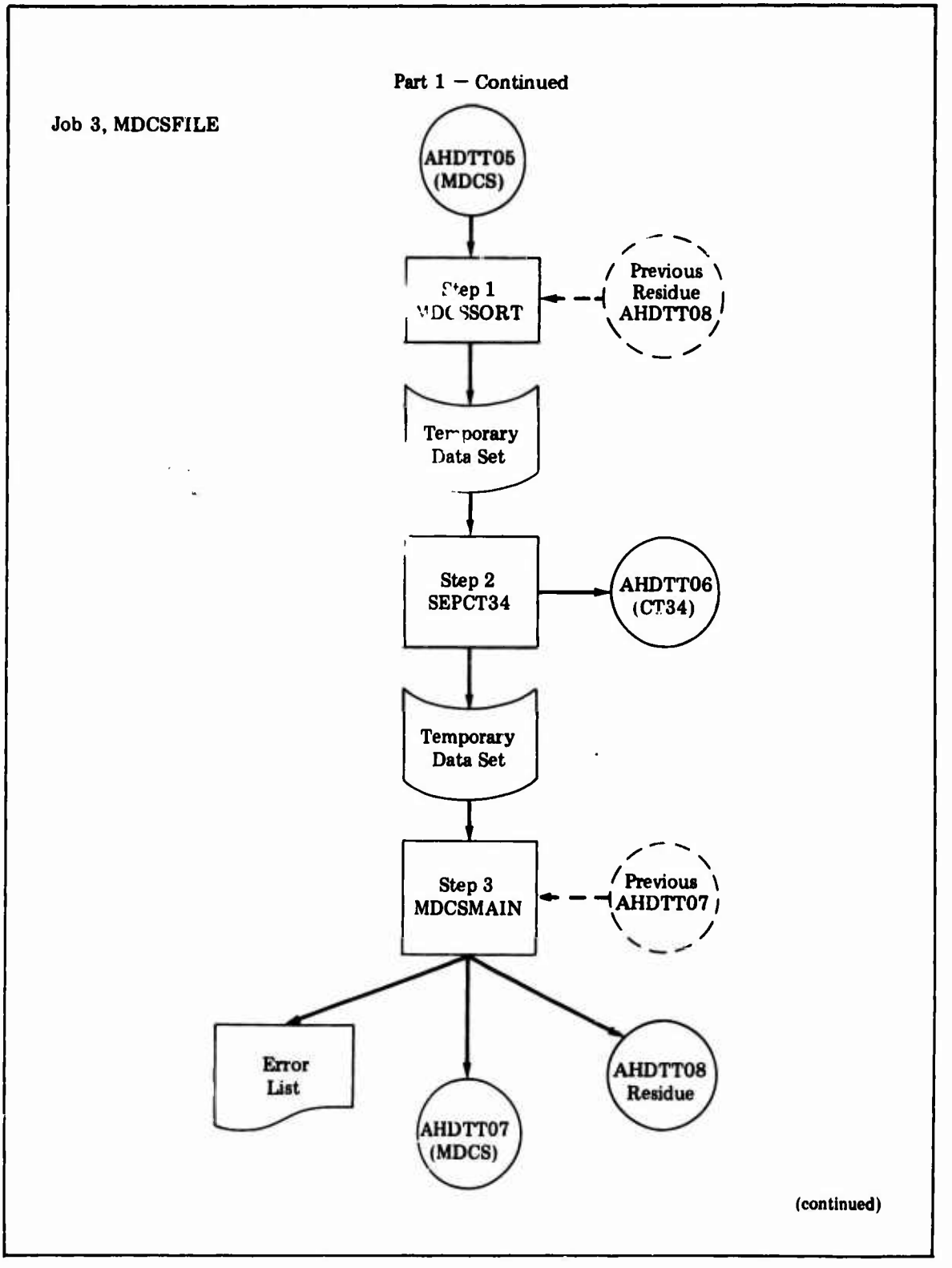


Figure 3 — Continued.

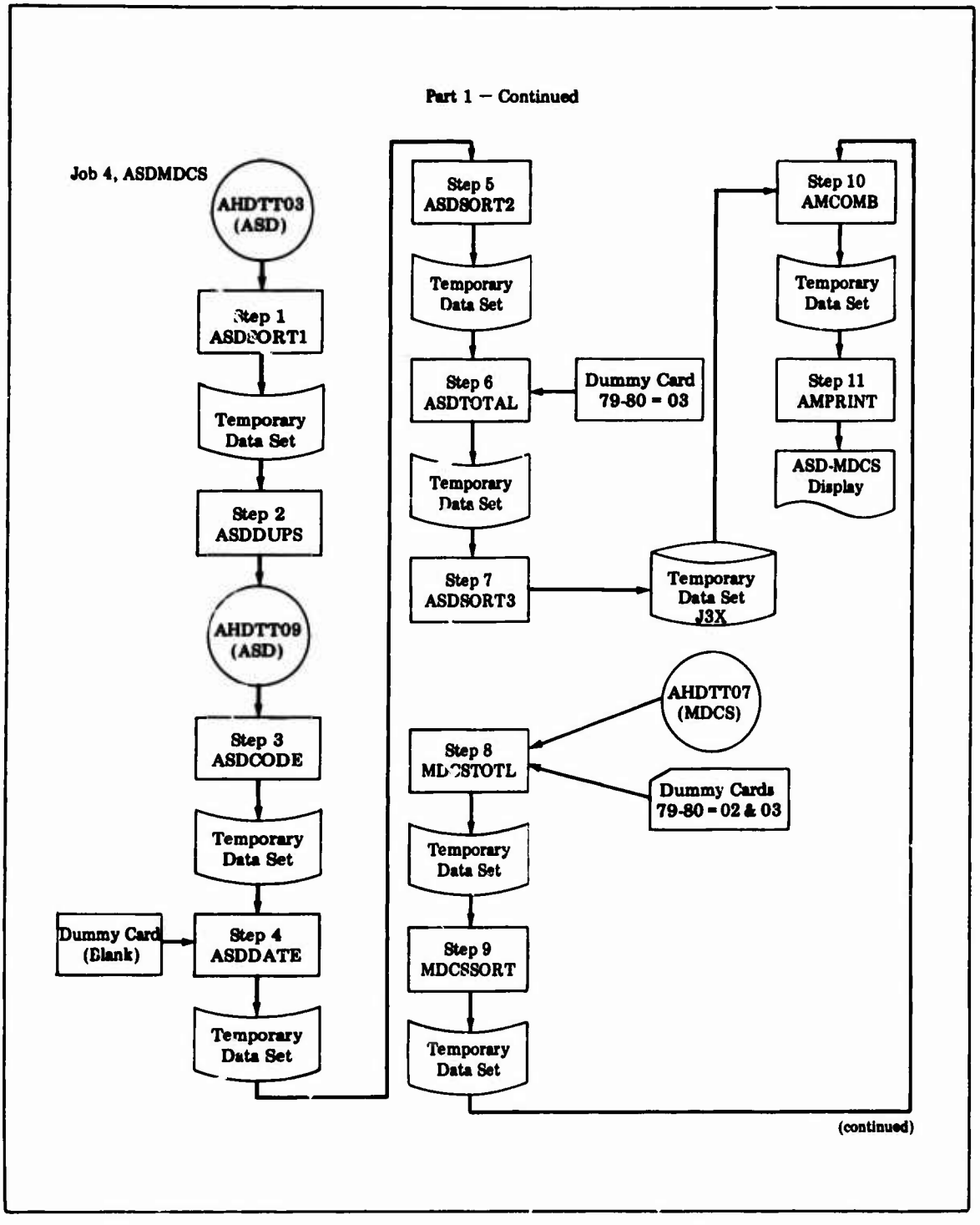


Figure 3 — Continued.

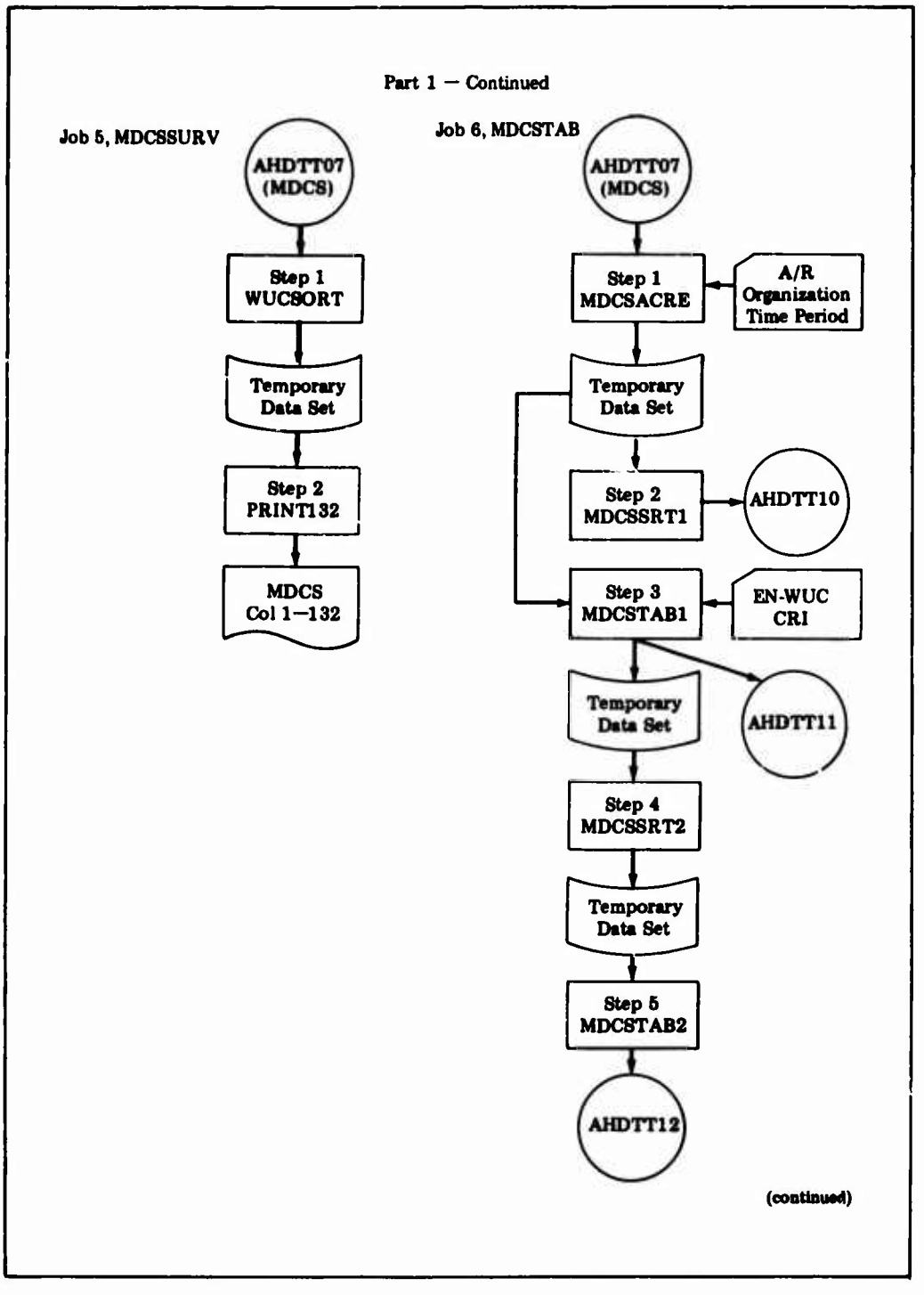


Figure 3 — Continued.

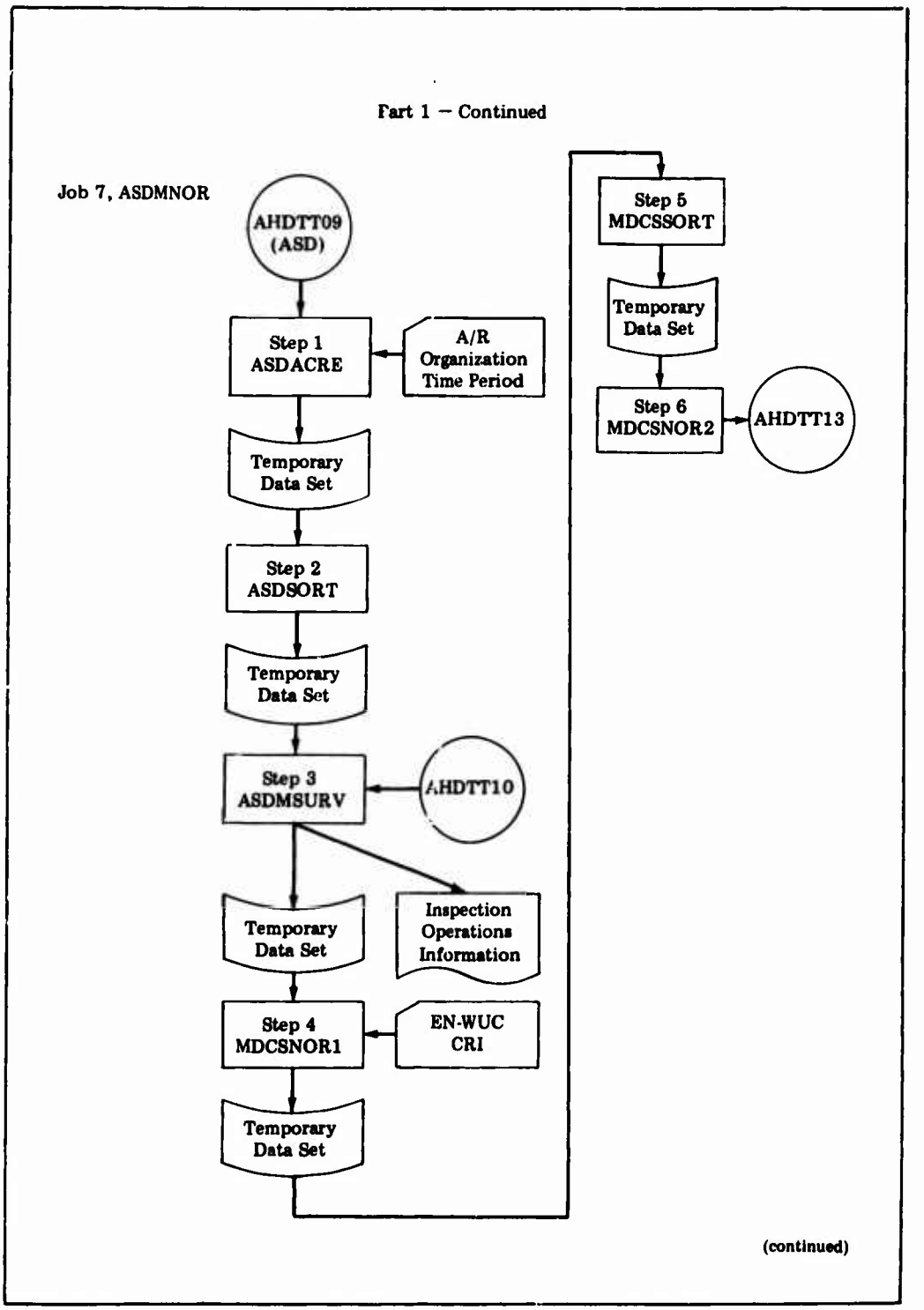
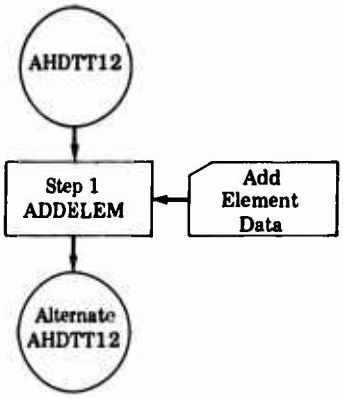


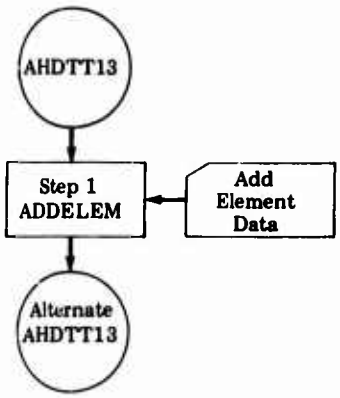
Figure 3 — Continued.

Part 1 — Continued

Job 8A, MDCSADD

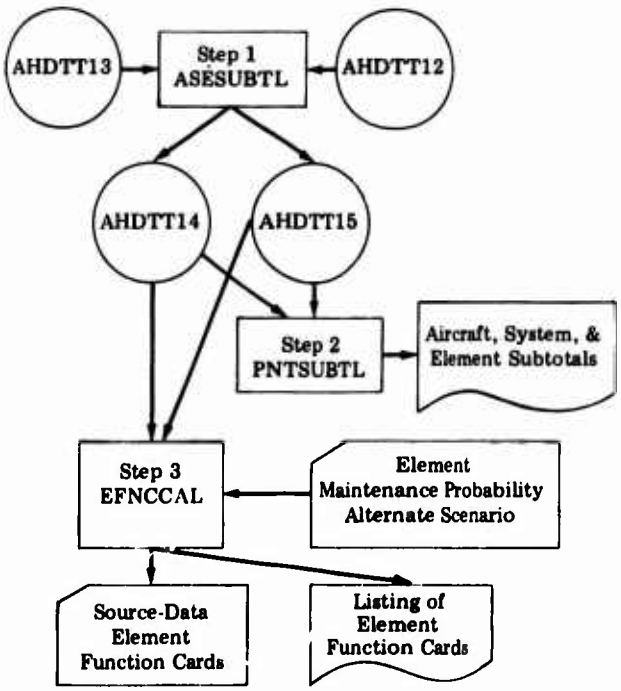


Job 8B, NORADD



Part 2 — R and M Input Function Calculations

Job 9, FUNCCAL1



(continued)

Figure 3 — Continued.

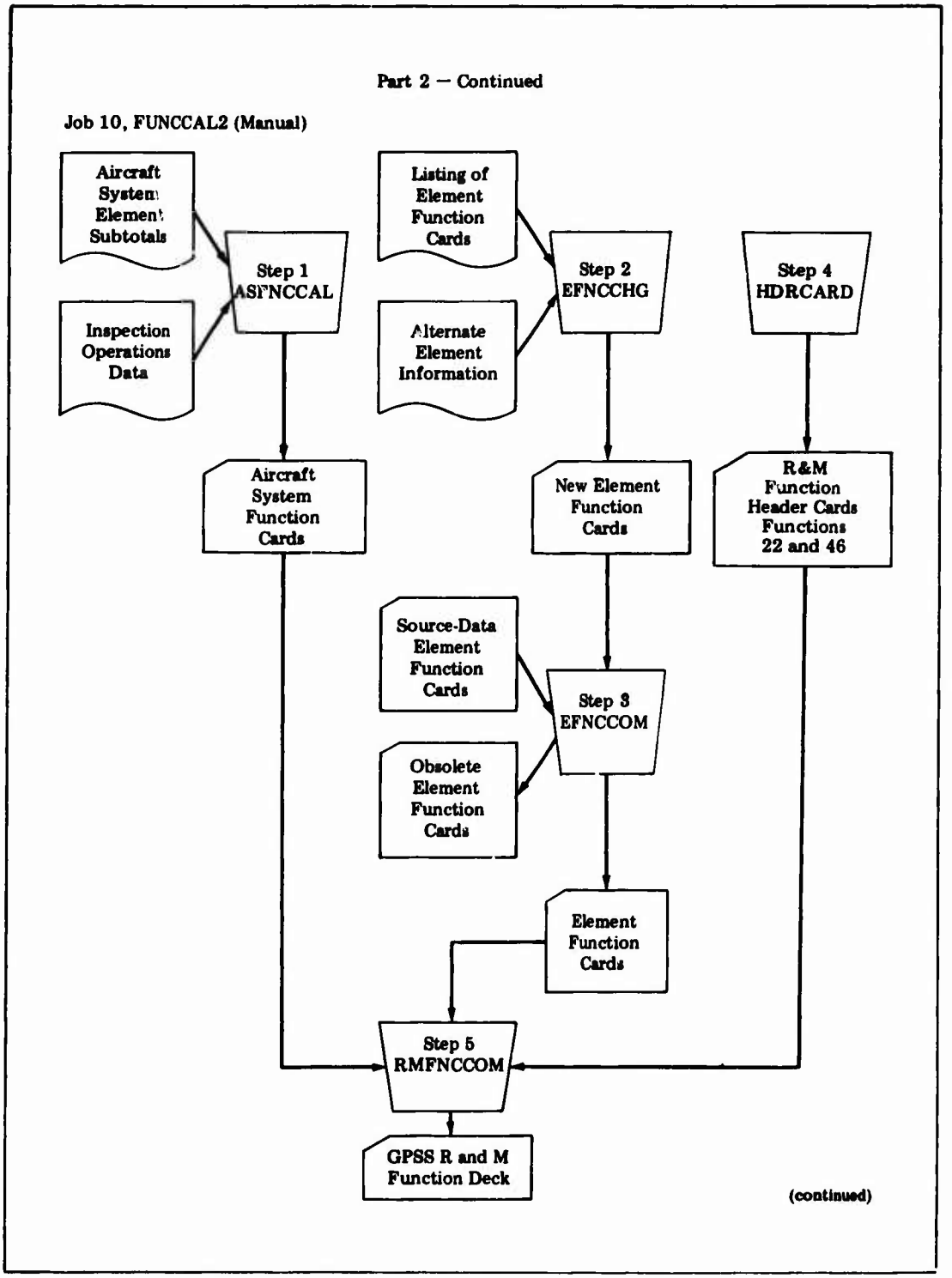


Figure 3 — Continued.

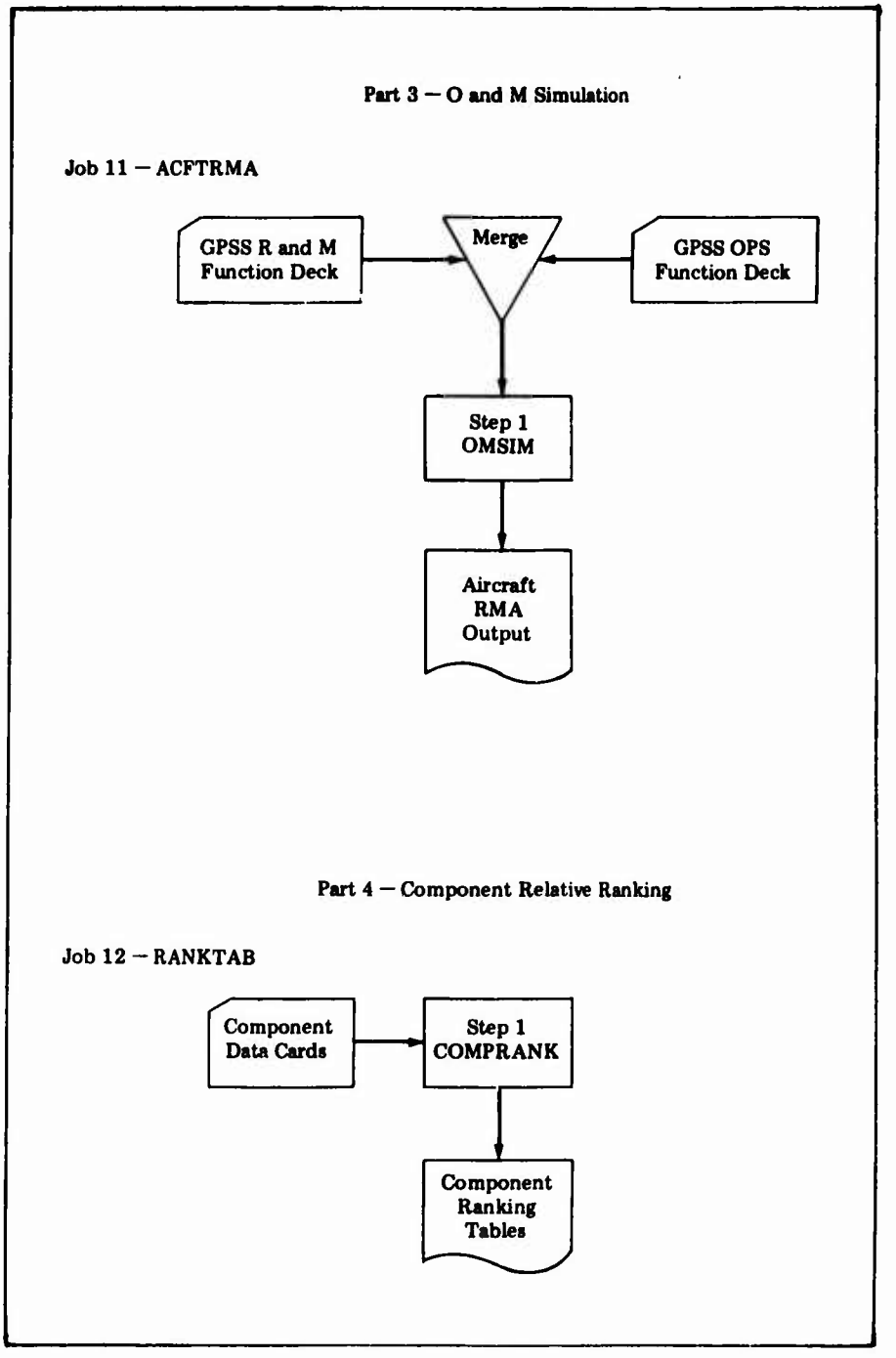


Figure 3 — Continued.

Job 2, SEPARATE

The purpose of Job 2 is to separate the data on the selected TEC(s) into three sets on tapes AHDTTO3 (ASD: 3-M CT 76s and 71s that provide flying-hour, other operational and readiness data), AHDTTO4 (SAF: 3-M CT 01s that provide operational support routine inspection — preflight, daily, etc., and general support data), and AHDTTO5 (MDCS: 3-M CT11s, 12s, 16s, 17s, 21s, 26s, 27s, 31s, 32s, and 34s that provide maintenance action and look phases of calendar/periodic-inspection data).

Tape AHDTTO3 becomes the basic input for a series of processing steps related to flying-hour and readiness determinations.

Tape AHDTTO4 provides summary SAF information. The SAF tape may be listed for general comparative information; however, since an Army-generated inspection scenario is being simulated, further processing is not required.

Tape AHDTTO5 becomes the basic input for determinations of unscheduled replacement and on- and off-equipment component-repair data and calendar-inspection frequency information.

Job 3, MDCS File

The purpose of Job 3 is to compile the many pieces of information from the various 3-M CTs contained on tape AHDTTO5 into single records of maintenance actions generated against the end-item aircraft or removed engine.

Job 3 is accomplished in three steps: (1) MDCSSORT, (2) SEPCT34, and (3) MDCSMAIN. Step 1 involves a sort. Step 2 separates any CT34s (repair-cycle data from Maintenance Action Form (MAF) Multi-copy 3) that were on tape AHDTTO5 and did not have Job Control Number (JCN) matches with other CTs, and it places them on tape AHDTTO6 for listing and review by the investigator (CT34s are frequently not included on 3-M data tapes provided by MSO and are not required for accomplishment of the program). Step 3 is the principal program in Job 3. MDCSMAIN eliminates redundant information; identifies and lists errors in the 3-M data; identifies residue CTs which are not in error, but for which insufficient information is available for association with a specific maintenance action, and outputs the CTs on tape AHDTTO8; and constructs composite records of maintenance events that contain all information available in the 3-M system for maintenance analysis, and outputs the records on file tape AHDTTO7. The format of a maintenance action file record, which is 1329 characters in length, is shown in Appendix I.

An existing residue tape, AHDTTO8, can be inputted to Step 1, and an existing file tape, AHDTTO7, can be inputted to Step 3 if the investigator subsequently acquires additional 3-M data and wishes to perform an update generating a new AHDTTO7 and AHDTTO8.

File tape AHDTTO7 is held for input in Jobs 4, 5, and 6.

Job 4, ASDMDCS

The purpose of Job 4 is to prepare a tabulation that surveys combined ASD and MDCS data in such a way that the investigator can judge the reasonableness and completeness of the data for subsequent R and M analysis.

The job consists of eleven steps. Steps 1 through 7 process ASD data from tape AHDTTO3, developed in Job 2, through a series of sort, duplicate-elimination, data-conversion, and ASD-totals-tabulation programs, and the results are retained in Temporary Data Set J3X. Steps 8 and 9 process the MDCS file tape AHDTTO7, developed in Job 3, through MDCS-totals-tabulation and sort programs, and the output from Step 9 is merged with J3X in Step 10, where the ASD-MDCS tabulation is completed. A card input to Step 8 can be used to select a specified time period from the MDCS file tape.

Step 11 is a display program that prints the tabulated results of Job 4. A sample of the tabulation is shown in Figure 4. The display is by organization (ORG), year and month (Y/M), and serial-number aircraft (BU/SER). The number of MAs during the month on the aircraft are shown under JCN/SYS, the total flying hours (in tenths) in the month for the aircraft under TFH/SYS, and the total Not Operationally Ready and awaiting-maintenance hours (in tenths) under T NOR/RMC HRS and T AWM/SYS HRS. Monthly, quarterly, and yearly totals are also provided by organization.

From his review of the results of Job 4, the investigator would make judgments about rejecting portions of data because of the absence, or obviously incomplete submittals, of either ASD or MDCS data. These decisions would be reflected in input to the first steps in Jobs 6 and 7. The investigator also has the option of retaining ASD and MDCS data, when there appears to be a question about the ASD input, and later developing flying-hour and other operational tabulation adjustments based on investigations of original data of the organization(s) in question, if possible.

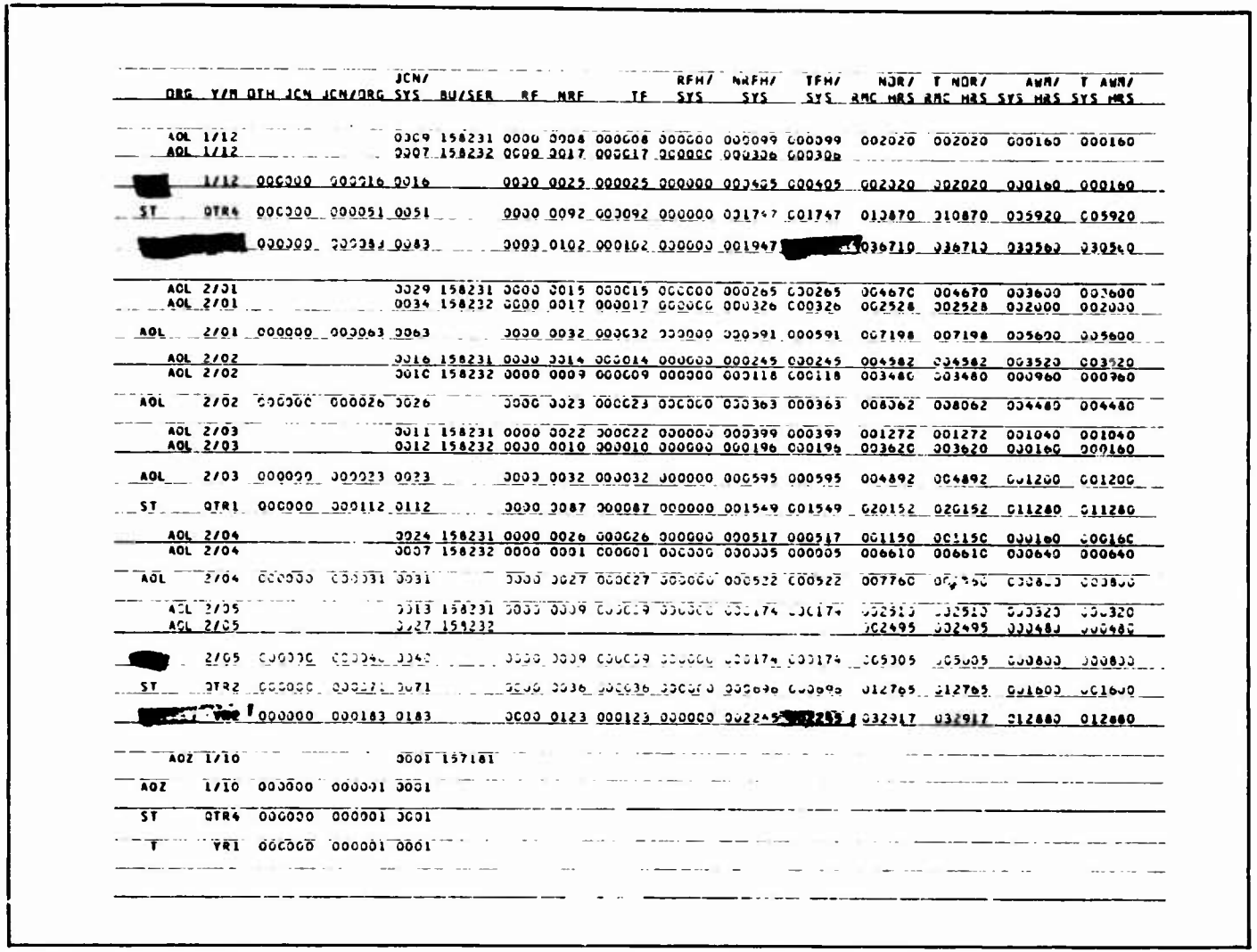
Job 5, MDCSSURV

The purpose of Job 5 is to provide the investigator with a listing of each MA record on the MDCS file tape in a maintained-item Work Unit Code (WUC) sequence. (The first 132 columns of each 1,329-character record are printed.)

This listing and the applicable aircraft-WUC manual (U.S. Navy Series H-1 Aircraft, NAVAIR 01-110HC-8, in the case of the UH-1N for this program) give the investigator a group of the number of MAs associated with various components of the helicopter during the data period and provide the information necessary for preparing a WUC Element Number (EN) Cross Reference Index (CRI) for system and element identification in the O and M simulation model.

Because of computer-operation considerations, the simulation model can typically accommodate an aircraft breakdown of 200 to 300 elements. Since an aircraft WUC breakdown typically involves more than 1,000 codes, the investigator must use judgment with respect to which WUC'd components will be specifically identified as elements and which components, subsystems, or systems will be amalgamated into elements for O and M simulation. The logical approach (that applied in the demonstration effort) is to identify specifically as elements those components that are of primary interest to the investigating agency. In this effort for the Eustis Directorate, time-change items and other major structural and dynamic-mechanical components were assigned separate ENs where possible.

The EN breakdown for the UH-1N developed in the program is shown in Appendix II. The EN-WUC CRI is keypunched on standard 80-column IBM data cards; 18 columns are used. Columns 1—7 contain the Navy WUC on the MDCS file tape, columns 8—14 contain the unique or amalgamated WUC associated with the EN (EWUC), and columns 15—18 contain the assigned EN (the first two digits reflecting the system and the second two digits the element within the system). The EN-WUC CRI developed in the program for the UH-1N is shown in Appendix III; the listing is in EN sequence.



ORG	Y/M	QTH	JCN	JCN/ORG	JCN/ SYS	BU/SER	RF	NRF	TF	RFH/ SYS	NRFH/ SYS	TFH/ SYS	NOR/ RMC HRS	T NOR/ RMC HRS	AWH/ SYS HRS	T AWH/ SYS HRS
AOL	1/12				0009	158231	0000	0008	000008	000000	000099	000099	002020	002020	000160	000160
AOL	1/12				0007	158232	0000	0017	000017	000000	000326	000326				
[redacted]	1/12	000000	000016	0016			0000	0025	000025	000000	000405	000405	002020	002020	000160	000160
ST	QTR4	000000	000051	0051			0000	0092	000092	000000	001747	001747	010870	010870	005920	005920
[redacted]		000000	000183	0183			0000	0102	000102	000000	001947	[redacted]	036710	036710	032560	030540
AOL	2/01				0029	158231	0000	0015	000015	000000	000265	000265	004670	004670	003600	003600
AOL	2/01				0034	158232	0000	0017	000017	000000	000326	000326	002520	002520	002000	002000
AOL	2/01	000000	000063	0063			0000	0032	000032	000000	000591	000591	007198	007198	005600	005600
AOL	2/02				0016	158231	0000	0014	000014	000000	000245	000245	004582	004582	003520	003520
AOL	2/02				0010	158232	0000	0009	000009	000000	000118	000118	003480	003480	000960	000960
AOL	2/02	000000	000026	0026			0000	0023	000023	000000	000363	000363	008062	008062	004480	004480
AOL	2/03				0011	158231	0000	0022	000022	000000	000399	000399	001272	001272	001040	001040
AOL	2/03				0012	158232	0000	0010	000010	000000	000196	000196	003620	003620	000160	000160
AOL	2/03	000000	000023	0023			0000	0032	000032	000000	000595	000595	004892	004892	001200	001200
ST	QTR1	000000	000112	0112			0000	0087	000087	000000	001549	001549	020152	020152	011280	011280
AOL	2/04				0024	158231	0000	0026	000026	000000	000517	000517	001150	001150	000160	000160
AOL	2/04				0007	158232	0000	0001	000001	000000	000035	000035	000610	000610	000640	000640
AOL	2/04	000000	000031	0031			0000	0027	000027	000000	000522	000522	007760	007760	005840	005840
AOL	2/05				0013	158231	0000	0009	000009	000000	000174	000174	002610	002610	000320	000320
AOL	2/05				0027	158232							002495	002495	000480	000480
[redacted]	2/05	000000	000040	0040			0000	0009	000009	000000	000174	000174	005005	005005	000800	000800
ST	QTR2	000000	000071	0071			0000	0036	000036	000000	000696	000696	012705	012705	001600	001600
[redacted]		000000	000183	0183			0000	0123	000123	000000	002265	[redacted]	032917	032917	012880	012880
AOZ	1/10				0001	157181										
AOZ	1/10	000000	000001	0001												
ST	QTR4	000000	000001	0001												
T	YR1	000000	000001	0001												

Figure 4. ASD-MDCS Data Display.

The EN-WUC CRI is required as input in Jobs 6 and 7.

Job 6, MDCSTAB

The purpose of Job 6 is to develop a summary tabulation of MA data by EN from the MDCS file tape AHDTTO7.

The job involves five steps. Step 1, MDCSACRE, is an accept-or reject program that requires input of a control card with A or R in column 1 to select how the program is to be used and one to 50 data cards with the organization code in columns 1—3, and time-period start and end dates in columns 4—7 and 8—11 (one-digit year followed by three-digit Julian day). If all data on the MDCS file tape AHDTTO7 are to be used, two blank cards are inputted. As discussed previously, the decisions relative to Step 1 are based on analysis of the results of Job 4. The output of Step 1 is a temporary data set.

Step 2, MDCSSRT1, sorts the temporary data set from Step 1 and outputs MDCS file tape AHDTT10, which is used as an input to Step 3 of Job 7.

The temporary data set from Step 1 is also inputted directly to Step 3, MDCSTAB1, to continue Job 6. In addition to the temporary data set, MDCSTAB1 requires card input of the EN-WUC CRI developed from Job 5. With these inputs, the program tabulates unscheduled-maintenance data from each 1,329-character MDCS MA record and outputs 45-character records to another temporary data set that includes — as appropriate for each MA — NWUC; EWUC; EN; on-aircraft When Discovered Code (WDC), Action Taken Code (ATC), primary Work Center Code (WCC), total active elapsed maintenance time (EMT), and total man-hours (MH); and off-equipment ATC, WCC, EMT, and MH. Scheduled inspection records and input records that do not contain sufficient data to prepare an output record in Step 3 are outputted as 1,329-character files on tape AHDTT11. Tape AHDTT11 is not used further; however, it can be listed and reviewed if desired.

The temporary data set from Step 3 is sorted in EN sequence in Step 4, MDCSSRT2, and inputted to Step 5, MDCSTAB2. MDCSTAB2 compiles the unscheduled MA records associated with an EN into single 327-character records for each EN covering the entire data period and outputs these new file records on tape AHDTT12. The file record layout is described in Appendix IV. A partial listing of the demonstration-case output from MDCSTAB2 is shown in Figure 5.

Job 7, ASDMNOR

The purpose of Job 7 is to provide inspection, flying-hour, trip-count, flight-count, and aircraft-flight-day-count (CT 76 submittals) information for later use in R and M function calculations for the O and M simulation, and to identify the MAs that caused or were associated with NOR conditions of the aircraft.

The job involves six steps. Step 1, ASDACRE, is similar to Step 1 in Job 5 (internally the program compares organization and date fields on CT71s and 76s instead of similar fields in an MDCS file record). ASD data tape AHDTTO9, generated in Job 4, is inputted, and accepted data are outputted as a temporary data set.

After being sorted in Step 2, the temporary data set is inputted with MDCS data tape AHDTT10 (generated in Job 6) to Step 3, ASDMSURV. ASDMSURV accomplishes two basic

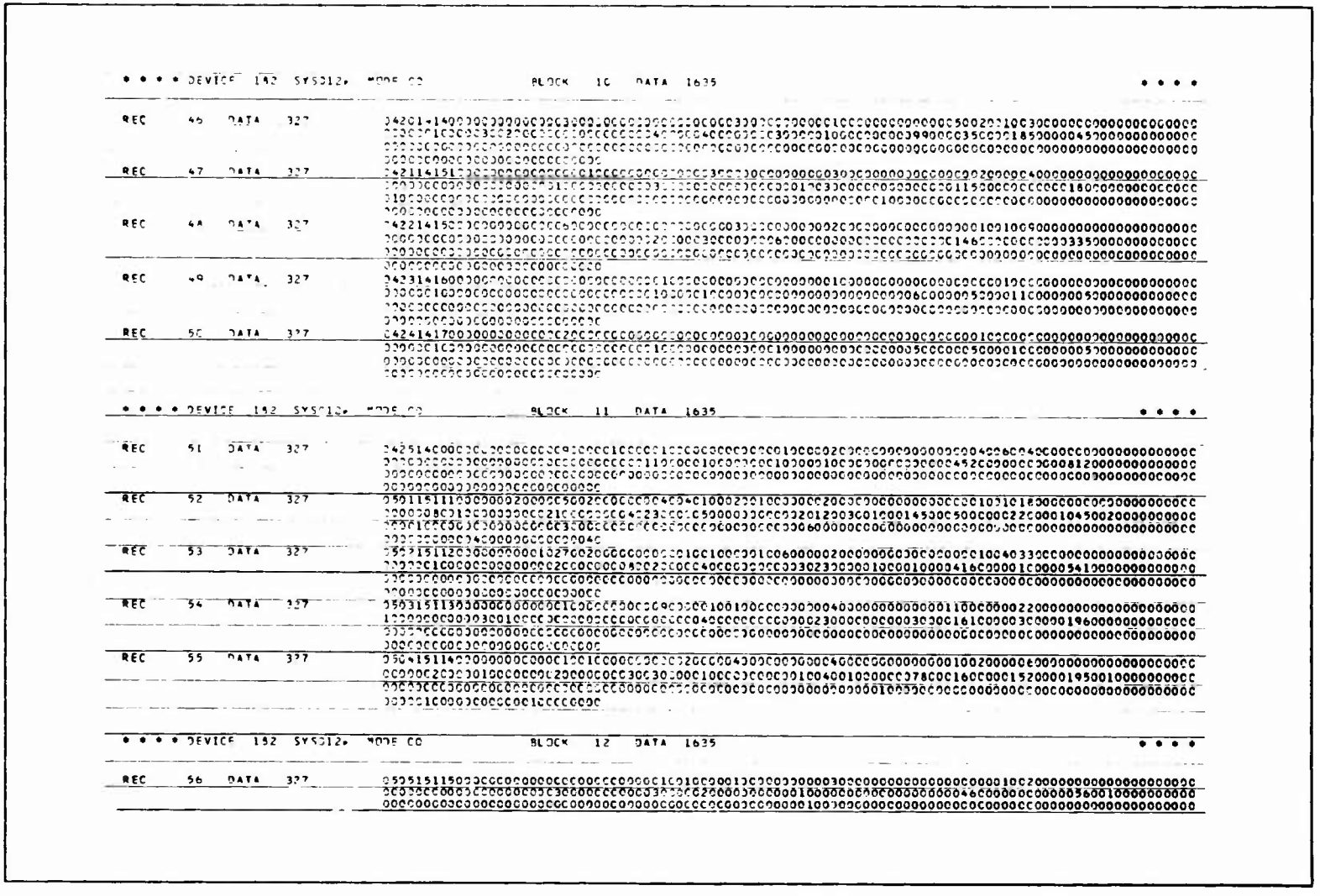


Figure 5. Partial Listing of UH-1N Data Tabulated by Navy, WDC, ATC, WCC — From Job 6, Step 5.

tasks. First, counts are made of the following, for each aircraft serial number (and a total count for the fleet):

- Look-phase inspections from the MDCS tape (primary interest is in Navy Type-Maintenance Codes P and Q, which represent odd and even calendar inspections that are approximately equivalent to Army periodic maintenance, PMP, events)
- Operations data from the ASD temporary data set:
  - CT76s (representing "trips from base", which are subsequently related to preflight counts)
  - Aircraft days of flying in data period
  - Flights (multiple flights can occur as parts of a trip in 3-M data submittal)
  - Flying hours

These counts are provided on an output listing. The ASD data, which apparently are most subject to difficulty in the 3-M system, can be adjusted by the investigator, as discussed previously in Job 4, on the basis of the availability of orginating-source data, etc., prior to application in the simulation model R and M function calculations.

Second, aircraft Not Operationally Ready (NOR) periods identified by the CT71s in the ASD temporary data set are compared with MA data on the MDCS tape, and the MA records with Navy WDCs B, D, E, H, J, K, or R associated with aircraft NOR periods are selected, NOR placed in columns 60—62 of the MDCS-MA record, and columns 1—62 of the record placed in the outputted temporary data set.

Step 4, MDCSNOR1, is performed in the same manner as Job 6, Step 3. The EN-WUC CRI is inputted with the temporary data set from ASDMSURV, and a new temporary data set is created with NWUC, EWUC, and EN in record columns 1—18 and the NOR-related WDC in record column 19.

After being sorted in Step 5, the new temporary data set is inputted to Step 6, MDCSNOR2, which is performed exactly as Step 5 in Job 6. A 327-column record is created for each of the selected WDC-NOR-related events formatted as shown in Appendix IV; however, each record is filled with 0s beyond the WDC-count fields that end with column 71. These records are outputted on file tape AHDTT13.

Jobs 8A and 8B, MDCSADD and NORADD

Jobs 8A and 8B are the eighth and ninth of the nine jobs in the Aircraft Historical Data Tabulation part of the algorithm.

The two jobs have the same purpose — to add elements and desired associated data counts to the aircraft breakdown for items that did not generate maintenance actions in the historical data period. One or both of the jobs may be bypassed by the investigator as deemed appropriate. One instance in which the jobs might be used is to add a low-failure item, for which no maintenance actions occurred, that is also a time-change item that the investigator wants to identify specifically for the simulation.

The elements would be added to tape outputs from Jobs 6 and 7, AHDTT12 and AHDTT13, in the formats indicated in the discussions of those jobs.

Data from any source that are put in the magnetic-tape format existing at the end of this set of jobs, or in the format to be described at the end of Job 9, Step 1, can be processed through the

balance of the algorithm by generally following the technique described. (Details of the preceding portion of the algorithm would, of course, have to be revised appropriately. The basic algorithm would not change if other Navy or Marine aircraft were selected as the baseline-data source.)

PART 2: R AND M INPUT FUNCTION CALCULATIONS

The purpose of the second part of the algorithm is to develop the R and M Function Deck, in GPSS format, for the O and M simulation model. The R and M Function Deck, in a program involving alternate component considerations, consists of a baseline deck reflecting the baseline component(s) installed in the aircraft and subdecks for each alternate component under consideration. These subdecks allow changes to aircraft, system, and element function inputs that reflect different component R and M characteristics.

Two jobs are involved; the first job is computerized, and the second must be performed manually. The manual approach was selected because of the nature of the effort — that is, data adjustments to reflect a maintenance scenario other than that represented in the original input data—and to incorporate alternate component configurations. (The investigator may wish to prepare several simple programs separately to perform the computations in Job 10, Step 1A. ARINC Research took this approach, using BASIC language programs and a time-sharing terminal.) The two jobs continue in consecutive numbering in the algorithm from Part 1.

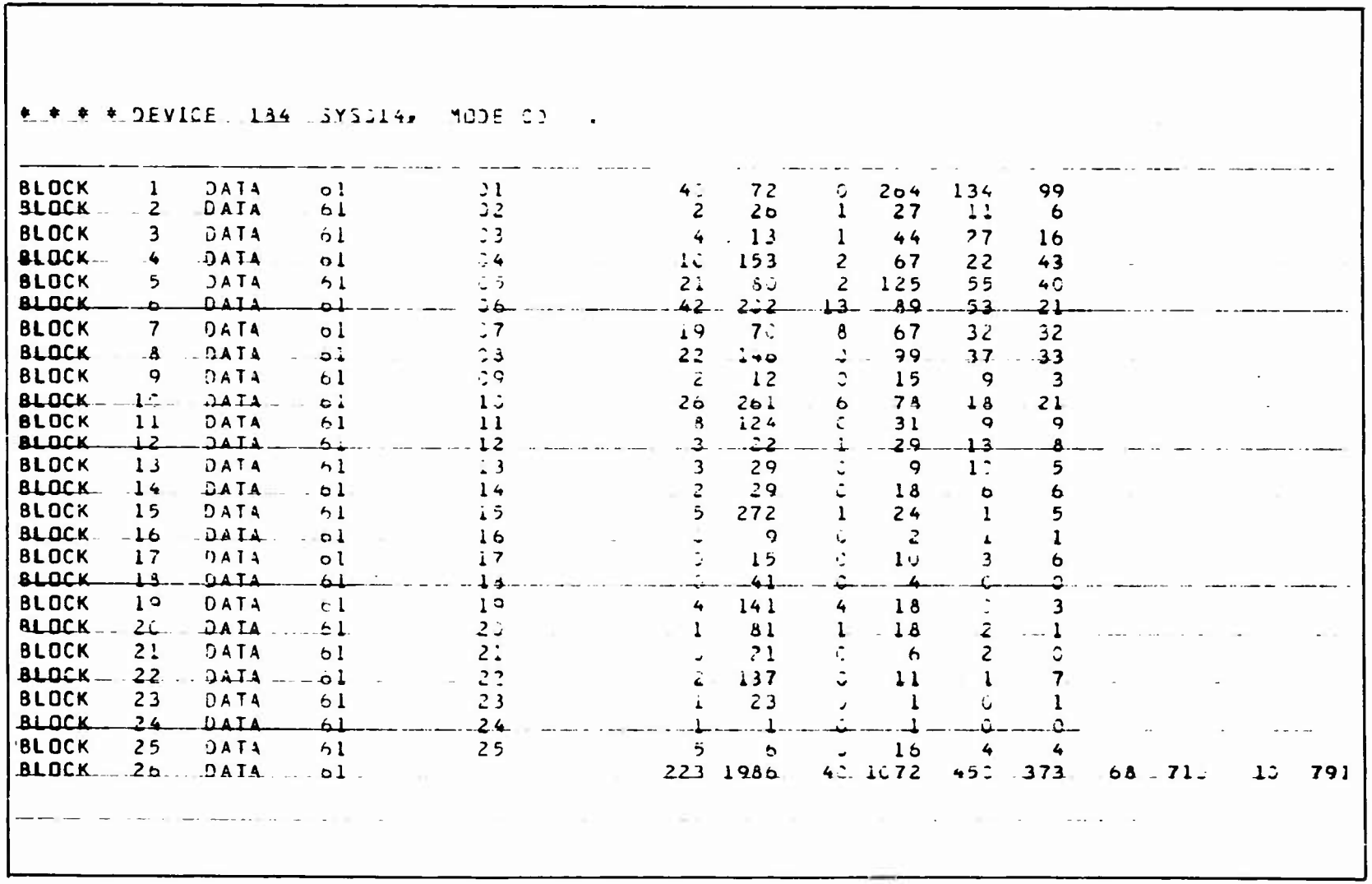
Job 9, FUNCCAL1

The purpose of Job 9 is to provide the aircraft and system subtotal data necessary to calculate the R and M functions, using the formulas defined for those levels in a previous section of the report, and to provide an initial data-card deck of calculated element-level R and M function input.

The job consists of three steps. Step 1, ASESUBTL, subtotals aircraft, system, and element-level maintenance data and performs calculations to determine the data elements previously described and coded in Table I (for subsequent use in R and M function calculations). Work is performed on source-data file tapes AHDTT12 and AHDTT13, or their alternates. Element-level maintenance information is outputted on file tape AHDTT14 and aircraft- and system-level information on file tape AHDTT15. Both output tapes are printed by a utility program in Step 2, PNTSUBTL (the aircraft and system information for use in manual calculations in Job 10 and the element information for review by the investigator, as desired).

Output field columns are as defined in Table I for all three levels, with system designations in columns 1—2 and EN designations in columns 1-4 of their respective output; columns 1—2 are blank at the aircraft level in the aircraft and systems output tape. The systems and aircraft-level output for the UH-1N are shown in Figure 6. A partial listing of the element-level output for the UH-1N is shown in Figure 7. Element unscheduled maintenance actions (based on maintenance-report when-discovered counts) during the data period of 11,804 flying hours are tabulated in Appendix II.

In Step 3, EFNCCAL, element-level R and M functions 24, 25, 26, 27, 28, 29, 30, 32, 33, 34, 35, 37, 40, 42, 43, 47, 52, 53, and 54 are calculated in accordance with the function formulas described previously, and the results are automatically punched on data cards in GPSS format and outputted from the program. The program also places the function number in columns 77—78 and the card sequence, within the function, in columns 79—80.



* * * * DEVICE 184 SYS014, MODE 00 .

BLOCK	1	DATA	01	01	43	72	0	264	134	99				
BLOCK	2	DATA	01	02	2	26	1	27	11	6				
BLOCK	3	DATA	01	03	4	13	1	44	27	16				
BLOCK	4	DATA	01	04	10	153	2	67	22	43				
BLOCK	5	DATA	01	05	21	80	2	125	55	40				
BLOCK	6	DATA	01	06	42	202	13	89	53	21				
BLOCK	7	DATA	01	07	19	70	8	67	32	32				
BLOCK	8	DATA	01	08	22	140	3	99	37	33				
BLOCK	9	DATA	01	09	2	12	0	15	9	3				
BLOCK	10	DATA	01	10	26	261	6	74	18	21				
BLOCK	11	DATA	01	11	8	124	0	31	9	9				
BLOCK	12	DATA	01	12	3	22	1	29	13	8				
BLOCK	13	DATA	01	13	3	29	0	9	10	5				
BLOCK	14	DATA	01	14	2	29	0	18	6	6				
BLOCK	15	DATA	01	15	5	272	1	24	1	5				
BLOCK	16	DATA	01	16	0	9	0	2	1	1				
BLOCK	17	DATA	01	17	0	15	0	10	3	6				
BLOCK	18	DATA	01	18	0	41	0	4	0	0				
BLOCK	19	DATA	01	19	4	141	4	18	0	3				
BLOCK	20	DATA	01	20	1	81	1	18	2	1				
BLOCK	21	DATA	01	21	0	21	0	6	2	0				
BLOCK	22	DATA	01	22	2	137	0	11	1	7				
BLOCK	23	DATA	01	23	1	23	0	1	0	1				
BLOCK	24	DATA	01	24	1	1	0	1	0	0				
BLOCK	25	DATA	01	25	5	6	0	16	4	4				
BLOCK	26	DATA	01		223	1986	43	1072	450	373	68	71	10	791

Figure 6. Listing of UH-1N Aircraft-Level and System-Level Maintenance Data Totals — From Job 9, Steps 1 and 2.

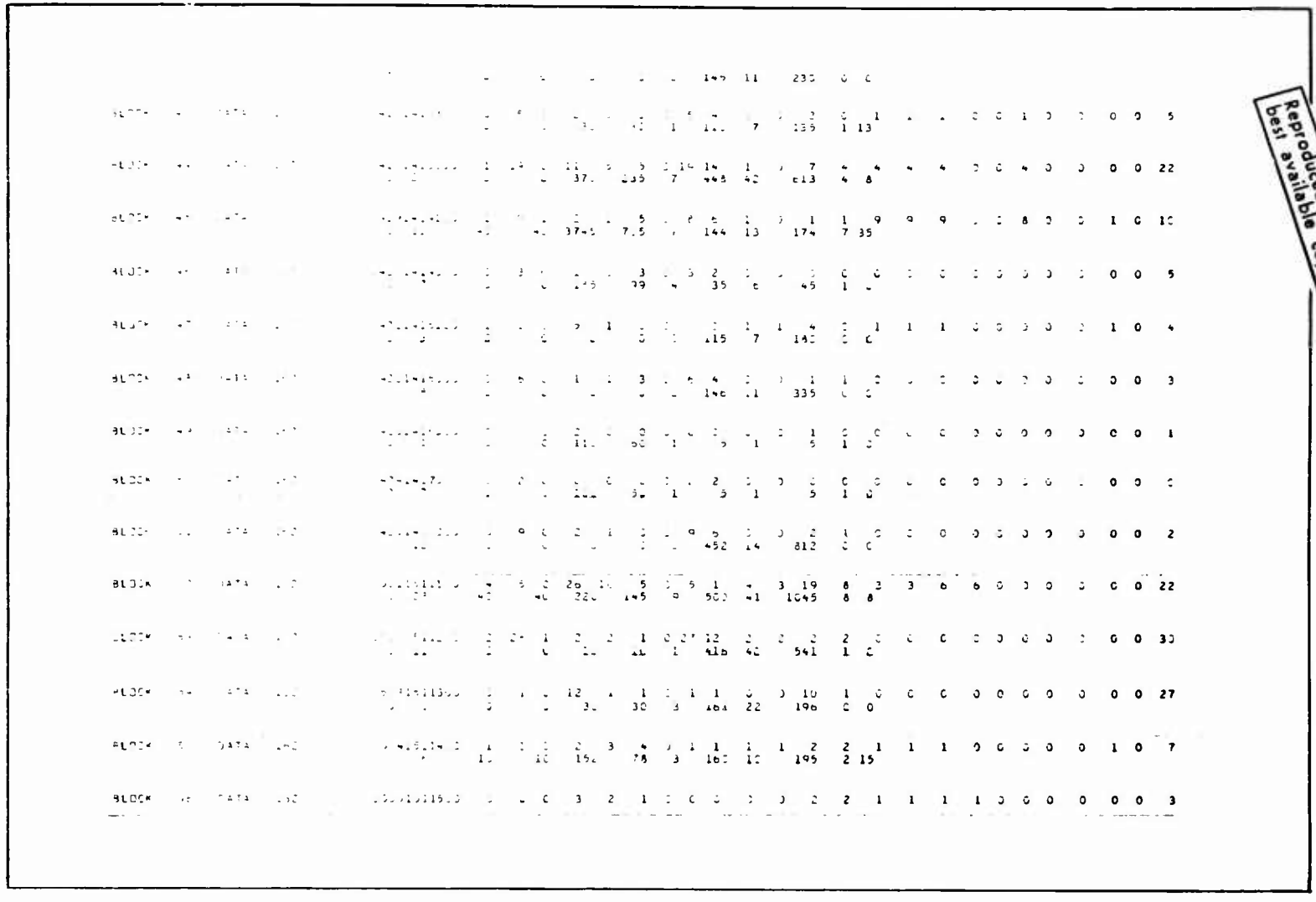


Figure 7. Partial Listing of UH-1N Element-Level Maintenance Data Subtotals — From Job 9, Steps 1 and 2.

Since an Army maintenance scenario is to be simulated [with three levels of off-equipment field maintenance — Organizational (IDSM), Direct Support, and General Support — and its own approach to component in-place repair versus removal and replacement during on-equipment actions] instead of the Navy/Marine scenario represented by the source data (with off-equipment field maintenance at an Intermediate Maintenance Activity), adjustments are required during calculation of R and M functions 37 and 52 as discussed in the previous function-calculation section. This adjustment necessitates input of probabilities of various maintenance-action occurrences associated with each element that reflect typical Army experience or practice. Four conditional-probability inputs are required for each element: the probability of removal and replacement given an MA (P_1), the probability of sending an element from O (IDSM) to DS given a R and R action (P_2), the probability of sending an element from DS to GS given that it was received in DS (P_3), and the probability of sending an element from GS to Depot given that it was received in GS (P_4). These probabilities, as applicable to a UH-1N (in the element breakdown in Appendix II) being maintained in an Army environment, were estimated primarily through the cooperation and support of experienced Army personnel at the Eustis Directorate and the Transportation School at Fort Eustis, Virginia; by the use of Army UH-1 Technical Manuals and UH-1 Maintenance Allocation Charts; by discussions with maintenance personnel during our visit to Fort Bragg, North Carolina; and by the review of other available Army aviation study and analysis reports. The probabilities inputted for the UH-1N elements are shown in Appendix V; the inputs are on one data-punch card for each element, with the EN in columns 1—4, P_1 in columns 5—7, P_2 in columns 8—10, P_3 in columns 11—13, and P_4 in columns 14—16.

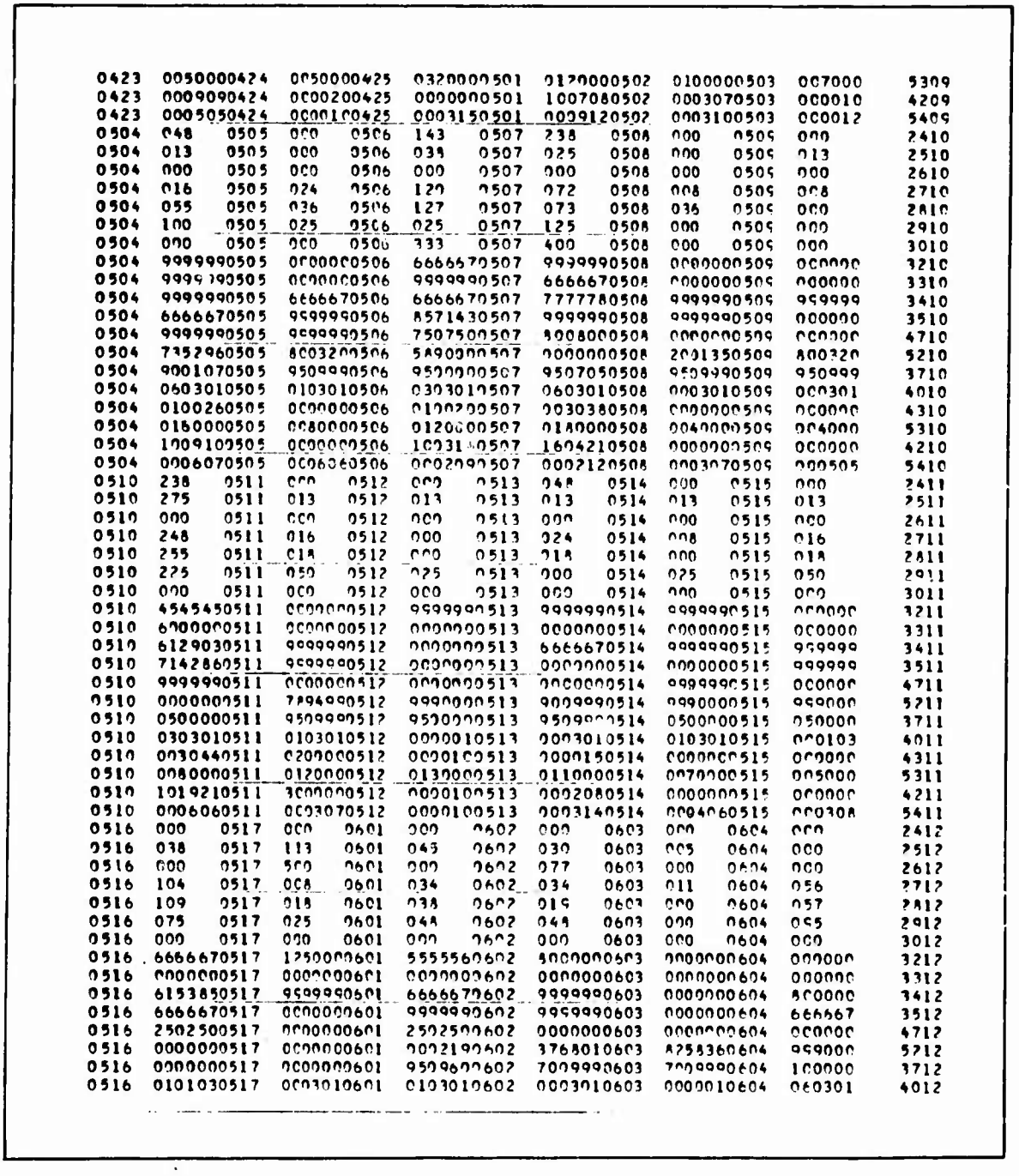
Step 3, EFNCCAL, also outputs a listing of the element-function cards showing the calculated results. A partial listing of the output is shown in Figure 8. It should be noted that the function cards for any given EN are grouped in the output listing. This enables the investigator to manually compare the data for the EN in the subgrouping of functions 52, 37, 40, 43, 53, 42, and 54 to determine any additional data adjustments that may be required in the overall aircraft-element breakdown. These manual changes are discussed in Job 10.

Job 10, FUNCCAL2

Job-numbering sequencing and labeling are applied to Job 10, though they are manual efforts. FUNCCAL2 involves three parallel efforts — Step 1, Steps 2 and 3, and Step 4, proceeding toward a final R and M Function compile, Step 5. The purpose of Job 10 is to prepare the final aircraft, systems, and element function input cards, the R and M function header cards, and Function 22 and 46 tables in GPSS format for compilation and input to the O and M simulation model in Job 11.

Step 1, ASFNCCAL, involves calculating aircraft and system-level Functions 2, 3, 5, 10, 11, 12, 13, 14, 16, 17, 18, 19, 20, and 21 as described in the previous R and M input section. Output data listed from Job 7, Step 3, and Job 9, Step 2, are used to perform the function calculations.

The UH-1N output from Job 9, aircraft and system when-discovered tabulations, is shown in Figure 6. If the UH-1N configuration aircraft that generated the data were to be simulated, the system and aircraft values shown would be used in the function calculations. However, when component alternatives are to be considered, in our technique-development effort, the element number representing the component being considered must be located in the element-level tabulations, also outputted from Job 9, Step 2 (shown in part in Figure 7). When the element in the historical data is not to be used as the baseline component, or when alternatives to the



```
0423 0050000424 0050000425 0320000501 0170000502 0100000503 007000 5309
0423 0009090424 0000200425 0000000501 1007080502 0003070503 000010 4209
0423 0005050424 0000100425 0003150501 0009120502 0003100503 000012 5409
0504 048 0505 000 0506 143 0507 238 0508 000 0509 000 2410
0504 013 0505 000 0506 033 0507 025 0508 000 0509 013 2510
0504 000 0505 000 0506 000 0507 000 0508 000 0509 000 2610
0504 016 0505 024 0506 120 0507 072 0508 008 0509 008 2710
0504 055 0505 036 0506 127 0507 073 0508 036 0509 000 2810
0504 100 0505 025 0506 025 0507 125 0508 000 0509 000 2910
0504 000 0505 000 0506 333 0507 400 0508 000 0509 000 3010
0504 9999990505 0000000506 6666670507 9999990508 0000000509 000000 3210
0504 9999990505 0000000506 9999990507 6666670508 0000000509 000000 3310
0504 9999990505 6666670506 6666670507 7777780508 9999990509 999999 3410
0504 6666670505 9999990506 8571430507 9999990508 9999990509 000000 3510
0504 9999990505 9999990506 7507500507 8008000508 0000000509 000000 4710
0504 7452960505 8003200506 5490000507 0000000508 2001350509 800320 5210
0504 9001070505 9509990506 9500000507 9507050508 9509990509 950999 3710
0504 0603010505 0103010506 0303010507 0603010508 0003010509 000301 4010
0504 0100260505 0000000506 0100200507 0030380508 0000000509 000000 4310
0504 0180000505 0080000506 0120000507 0140000508 0040000509 004000 5310
0504 1009100505 0000000506 1003100507 1604210508 0000000509 000000 4210
0504 0006070505 0006060506 0002090507 0002120508 0003070509 000505 5410
0510 238 0511 000 0512 000 0513 048 0514 000 0515 000 2411
0510 275 0511 013 0512 013 0513 013 0514 013 0515 013 2511
0510 000 0511 000 0512 000 0513 000 0514 000 0515 000 2611
0510 248 0511 016 0512 000 0513 024 0514 008 0515 016 2711
0510 255 0511 018 0512 000 0513 018 0514 000 0515 018 2811
0510 225 0511 050 0512 025 0513 000 0514 025 0515 050 2911
0510 000 0511 000 0512 000 0513 000 0514 000 0515 000 3011
0510 4545450511 0000000512 9999990513 9999990514 9999990515 000000 3211
0510 6000000511 0000000512 0000000513 0000000514 0000000515 000000 3311
0510 6129030511 9999990512 0000000513 6666670514 9999990515 999999 3411
0510 7142860511 9999990512 0000000513 0000000514 0000000515 999999 3511
0510 9999990511 0000000512 0000000513 0000000514 9999990515 000000 4711
0510 0000000511 7994990512 9990000513 9009990514 9990000515 999000 5211
0510 0500000511 9509990512 9500000513 9509000514 0500000515 050000 3711
0510 0303010511 0103010512 0000010513 0003010514 0103010515 000103 4011
0510 0030440511 0200000512 0000100513 0000150514 0000000515 000000 4311
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0510 1019210511 3000000512 0000100513 0002080514 0000000515 000000 4211
0510 0006060511 0003070512 0000100513 0003140514 0004060515 000308 5411
0516 000 0517 000 0601 000 0602 000 0603 000 0604 000 2412
0516 038 0517 113 0601 043 0602 030 0603 005 0604 000 2512
0516 000 0517 500 0601 000 0602 077 0603 000 0604 000 2612
0516 104 0517 008 0601 034 0602 034 0603 011 0604 056 2712
0516 109 0517 018 0601 038 0602 015 0603 000 0604 057 2812
0516 075 0517 025 0601 044 0602 044 0603 000 0604 055 2912
0516 000 0517 000 0601 000 0602 000 0603 000 0604 000 3012
0516 6666670517 1250000601 5555560602 4000000603 0000000604 000000 3212
0516 0000000517 0000000601 0000000602 0000000603 0000000604 000000 3312
0516 6153850517 9599990601 6666670602 9999990603 0000000604 800000 3412
0516 6666670517 0000000601 9999990602 9959990603 0000000604 666667 3512
0516 2502500517 0000000601 2502500602 0000000603 0000000604 000000 4712
0516 0000000517 0000000601 0002190602 3768010603 8258360604 959000 5212
0516 0000000517 0000000601 9599600602 7009990603 7009990604 100000 3712
0516 0101030517 0003010601 0103010602 0003010603 0000010604 060301 4012
```

Figure 8. Partial Listing of UH-1N Element-Level GPSS R and M Input Functions — From Job 9, Step 3.

baseline component are being considered, data adjustments must be made in the appropriate system and aircraft tabulations. The adjustments essentially effect removal of the source-data component and insertion of an alternative or alternatives.

For example, the UH-1H main rotor blade (MRB) was to be the baseline component in our sample exercise, and four alternate MRBs were to be considered. Necessary MRB data were developed, primarily from Reference 1, and substituted for the UH-1N MRB data (Reference EN 0504 in Figure 7) in system 05 and aircraft tabulations. (A separate set of Step 1 function calculations was also completed with each alternate MRB configuration substituted in the system.)

With reference to Table I for field-column headings, the system and aircraft data shown in Figure 6 were adjusted in accordance with the tabulations shown in Table V. Appendix VI to this report provides a summary of our approach to derivation of alternate MRB input information. (Since our basic interest was in technique development, we attempted to develop the best input data possible without exhaustive research and time expenditure. As the technique is applied in the future, the investigator must make a decision concerning the extent of his data-development effort.)

When the necessary maintenance information is developed, it is used with inspection and operating data developed during Job 7, Step 3, to perform the aircraft and system-level function calculations. The results are keypunched in GPSS format and held for input to Step 5 of the manual job.

Step 2, EFNCCHG, involves changing element-level Functions 24, 25, 26, 27, 28, 29, 30, 32, 33, 34, 35, 37, 40, 42, 43, 47, 52, 53, and 54 to the extent that they could be affected when the component under consideration is changed.

For example, the MRB (EN 0504) change that was used for demonstration purposes could affect all of the 05 system-element calculations in Functions 24-29 and the 0504 element calculations in the balance of the functions. The data in Table V represent the information required to make the necessary changes in calculating Functions 24-35 as one MRB is substituted for another; they are typical of the information required when alternatives to any component in the simulation are being considered. Derivations of the information shown in Table V and the information required to calculate Functions 37—54 for the different MRBs are discussed in Appendix VI.

Step 2 also entails a review of the function output listing from Job 9, Step 3, for the elements in the baseline aircraft that are not involved in component-change considerations but could be affected if a maintenance scenario change was made in the historical data — as in the demonstration case. The purpose of this review is to ensure that where the revised maintenance scenario calls for on-aircraft repair and removal and replacement or off-equipment repair in Functions 37 and 52, appropriate work-center, mean-elapsed-maintenance time, and manpower information is provided in Functions 40, 42, 43, 53, and 54. The program in Job 9, Step 3, automatically groups and lists these functions by element, as shown in Figure 8, to facilitate this effort. For example, if Function 52 showed a percent DS repair given receipt and all of the source-data actions (Navy) had been performed on the aircraft, needed data would be missing from Functions 40, 42, 43, and 54. The investigator uses any sources at his disposal to obtain data on the elements not under investigation to fill voids that might exist. As the simulation model is used over a period of time, the investigator might consider a continuing program of updating and improving the overall element baseline inputs as additional information becomes available.

TABLE V. CHANGES TO EN 0504, SYSTEM 05, AND AIRCRAFT WHEN-DISCOVERED COUNTS FOR ALTERNATE MAIN ROTOR BLADE CONSIDERATIONS

Data Codes (Ref. Table I)	When-Discovered Description	Reduction by Historical UH-1N Count	Count Increases				
			Baseline UH-1H	Alternate I	Alternate II	Alternate III	Alternate IV
1E/1S/1A	Aircrew*	1	0	0	0	0	0
2E/2S/2A	In-flight*	1	11.30	9.95	3.28	2.11	5.95
3E/3S/3A	In-flight abort	0	1.55	3.99	2.70	1.50	2.56
4E/4S/4A	Preflight*	2	4.31	6.09	12.61	13.00	10.09
5E/5S/5A	Daily*	3	0	0.72	0	1.65	0
6E/6S/6A	Periodic*	4	1.15	0	0.40	0	0.51
7E/7A	Aircrew abort	0	0	0	0	0	0
8E	In-flight, no abort	1	0	0	0	0	0
9E	In-flight, no abort NOR	1	9.75	5.96	0.58	0.61	3.39
10E	Aircrew, no abort	1	0	0	0	0	0
11E	Aircrew, no abort NOR	1	0	0	0	0	0
12E/8A	Preflight NOR	2	' 31	6.09	12.61	13.00	10.09
13E	Daily NOR	2	0	0.72	0	1.65	0
9A	Bad part from supply (No changes)						
35E/10A	Draws on supply	2	13.9	13.2	13 7	13.7	15.3
Total MAs in Data Period		11	16.76	16.76	16.[illegible]	16.76	16.55**

*Only descriptions marked with asterisk contribute to total MA count.

**MA total for Alternate IV equals 16.52 (see Appendix V); difference reflects rounding.

In Step 3, the results of the revised element calculations developed in Step 2 are then keypunched on replacement function cards in GPSS format and merged with the deck of source-data element function cards from Job 9, Step 3.

In Step 4 of Job 10, HDRCARD, R and M function header cards are defined, and tables are prepared to indicate the number of elements in each aircraft system and to assign sequential numbers (starting from 1) to each element number.

The header cards and tables, which become Functions 22 and 46, are then keypunched in GPSS format and merged in Step 5, RMFNCCOM, with the GPSS data cards from Steps 1 and 3.

A listing of the resulting R and M Function Deck, as developed for the MRB demonstration exercise, is shown in Appendix VII.

PART 3: O AND M SIMULATION, JOB 11, ACFTRMA

Job 11 consists of one step, OMSIM, which is the exercise of the O and M simulation model developed in the program. Input data, in addition to the R and M data discussed in Job 10, are discussed in the Army O and M Simulation Model and Simulation Model Input sections of this report. The additional data input is primarily in the category of operations and logistics; however, data are also provided to define scheduled maintenance activity, element/component time-change limits, etc. These inputs reflect the Army O and M scenario as developed through review of UH-1 Technical Manuals and discussions with Army personnel at Fort Bragg, North Carolina, and Fort Eustis, Virginia. The simulated Army operations scenario includes the following:

- There is one platoon of 11 utility helicopters.
- The flying program is five flying days per week.
- Full-duration missions cover a period of 1.5 hours.
- A demand of 41 flying hours is placed on each aircraft over a four-week period.
- The flight schedule during each flying day is as follows:

Time	Number of Aircraft
0800	5
1000	3
1200	2
1400	3
1600	2

- A standby aircraft is preflighted and ready during the scheduled flying intervals.
- Delays of up to 30 minutes beyond a scheduled flight time, because of aircraft nonavailability, can occur without cancellation of the flight. After 30 minutes, the flight requirement is canceled.
- Each simulation interval covers a four-week period. (The investigator can simulate a series of these intervals to develop confidence in outputted data. In the UH-1N evaluation, with alternate MRBs, six months were simulated.)

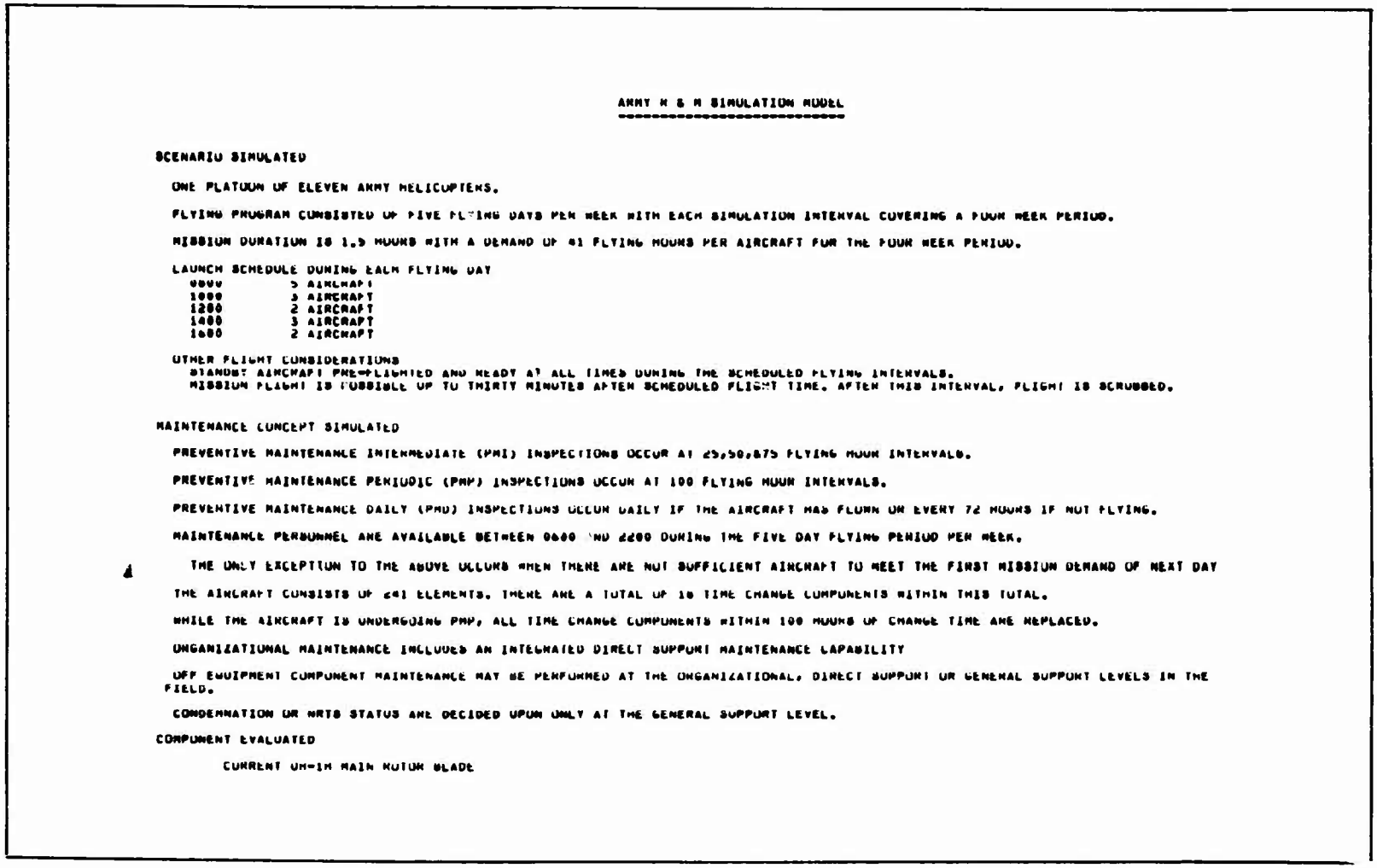
The simulated Army maintenance concept includes the following:

- Preventive Maintenance Intermediate (PMI) inspections occur at intervals of 25, 50, and 75 flying hours after each 100-hour inspection.
- Preventive Maintenance Periodic (PMP) inspections occur at 100-flying-hour intervals.
- Preventive Maintenance Daily (PMD) inspections occur daily if the aircraft has flown, or every 72 hours if it has not flown.
- Maintenance personnel are available between 0600 and 2200 during the five-flying-day week. Extended hours are worked, however, when there are insufficient aircraft to meet the first mission demand of the next day.
- The helicopter platoon is supported by a service platoon, with integrated direct support maintenance (IDSM) capability, at the Organizational level. Removed-component maintenance is performed at Organizational (IDSM), Direct Support, or General Support levels (or General Support can condemn or NRTS the component to Depot).
- In the demonstration effort with the UH-1N and alternate MRBs, the aircraft simulated consisted of 241 elements, as defined in Appendix II. Eighteen time-change components within this total (as identified in TM55-1520-210-20, Organizational Maintenance Manual, Army Model UH-1D/H Helicopters) are randomly assigned cumulative operating hours at the start of a simulation exercise. (In the simulation model, the process of defining cumulative operating hours is actually accomplished by randomly initializing on the complement—the time remaining to overhaul or retirement—and assigning a projected time of removal.)
- All time-change components within 100 hours of their overhaul or retirement limit are replaced while the aircraft is undergoing PMP.
- No limitations are imposed on manpower; that is, work is never delayed because of unavailability of personnel during the working hours specified.
- No maintenance facility limitations are imposed; that is, any number of randomly identified jobs can be in a work-center facility at a given time.
- There is no limitation on the availability of replacement elements/parts; that is, if an element is determined to require removal and replacement on an aircraft, a replacement element is available from supply (no repair delays or cannibalization actions are induced because of supply).

The results of computer-simulation exercises are outputted in the form of standard GPSS output entities (tables, matrices, etc.—described in detail in the computer software package submitted separately in this program) and an Output Editor, designed to present desired summary results for any particular analysis effort.

In the demonstration exercise, the simulation approach used for running the model was to conduct six one-month simulations of platoon O and M. The resulting outputs of interest were averaged to arrive at conclusions based on six months of operation. Simulations were conducted with the UH-1H MRB installed (in terms of R and M data) in the 11 platoon aircraft to establish baseline results, and subsequent simulations were made with each of the alternate MRBS (I, II, III, and IV) installed to develop results with the alternate components.

A sample Output Editor, for a one-month baseline system (UH-1N with UH-1H MRB) simulation, is shown in Figure 9. The data are generally described by the column headings printed in the editor; however, where amplification is appropriate, notations have been added. In addition to the data in the Output Editors from the simulation runs, provisions were made to compute the intrinsic availability of the aircraft two ways and record the results in full-word



ARMY M & M SIMULATION MODEL

SCENARIO SIMULATED

ONE PLATOON OF ELEVEN ARMY HELICOPTERS.

FLYING PROGRAM CONSISTED OF FIVE FLYING DAYS PER WEEK WITH EACH SIMULATION INTERVAL COVERING A FOUR WEEK PERIOD.

MISSION DURATION IS 1.5 HOURS WITH A DEMAND OF 41 FLYING HOURS PER AIRCRAFT FOR THE FOUR WEEK PERIOD.

LAUNCH SCHEDULE DURING EACH FLYING DAY
0800 5 AIRCRAFT
1000 3 AIRCRAFT
1200 2 AIRCRAFT
1400 3 AIRCRAFT
1600 2 AIRCRAFT

OTHER FLIGHT CONSIDERATIONS
STANDBY AIRCRAFT PRE-FLIGHTED AND READY AT ALL TIMES DURING THE SCHEDULED FLYING INTERVALS.
MISSION FLIGHT IS POSSIBLE UP TO THIRTY MINUTES AFTER SCHEDULED FLIGHT TIME. AFTER THIS INTERVAL, FLIGHT IS SCRUBBED.

MAINTENANCE CONCEPT SIMULATED

PREVENTIVE MAINTENANCE INTERMEDIATE (PMI) INSPECTIONS OCCUR AT 25,50,&75 FLYING HOUR INTERVALS.

PREVENTIVE MAINTENANCE PERIODIC (PMP) INSPECTIONS OCCUR AT 100 FLYING HOUR INTERVALS.

PREVENTIVE MAINTENANCE DAILY (PMD) INSPECTIONS OCCUR DAILY IF THE AIRCRAFT HAS FLOWN OR EVERY 72 HOURS IF NOT FLYING.

MAINTENANCE PERSONNEL ARE AVAILABLE BETWEEN 0600 AND 2200 DURING THE FIVE DAY FLYING PERIOD PER WEEK.

THE ONLY EXCEPTION TO THE ABOVE OCCURS WHEN THERE ARE NOT SUFFICIENT AIRCRAFT TO MEET THE FIRST MISSION DEMAND OF NEXT DAY

THE AIRCRAFT CONSISTS OF 241 ELEMENTS. THERE ARE A TOTAL OF 18 TIME CHANGE COMPONENTS WITHIN THIS TOTAL.

WHILE THE AIRCRAFT IS UNDERGOING PMP, ALL TIME CHANGE COMPONENTS WITHIN 100 HOURS OF CHANGE TIME ARE REPLACED.

ORGANIZATIONAL MAINTENANCE INCLUDES AN INTEGRATED DIRECT SUPPORT MAINTENANCE CAPABILITY

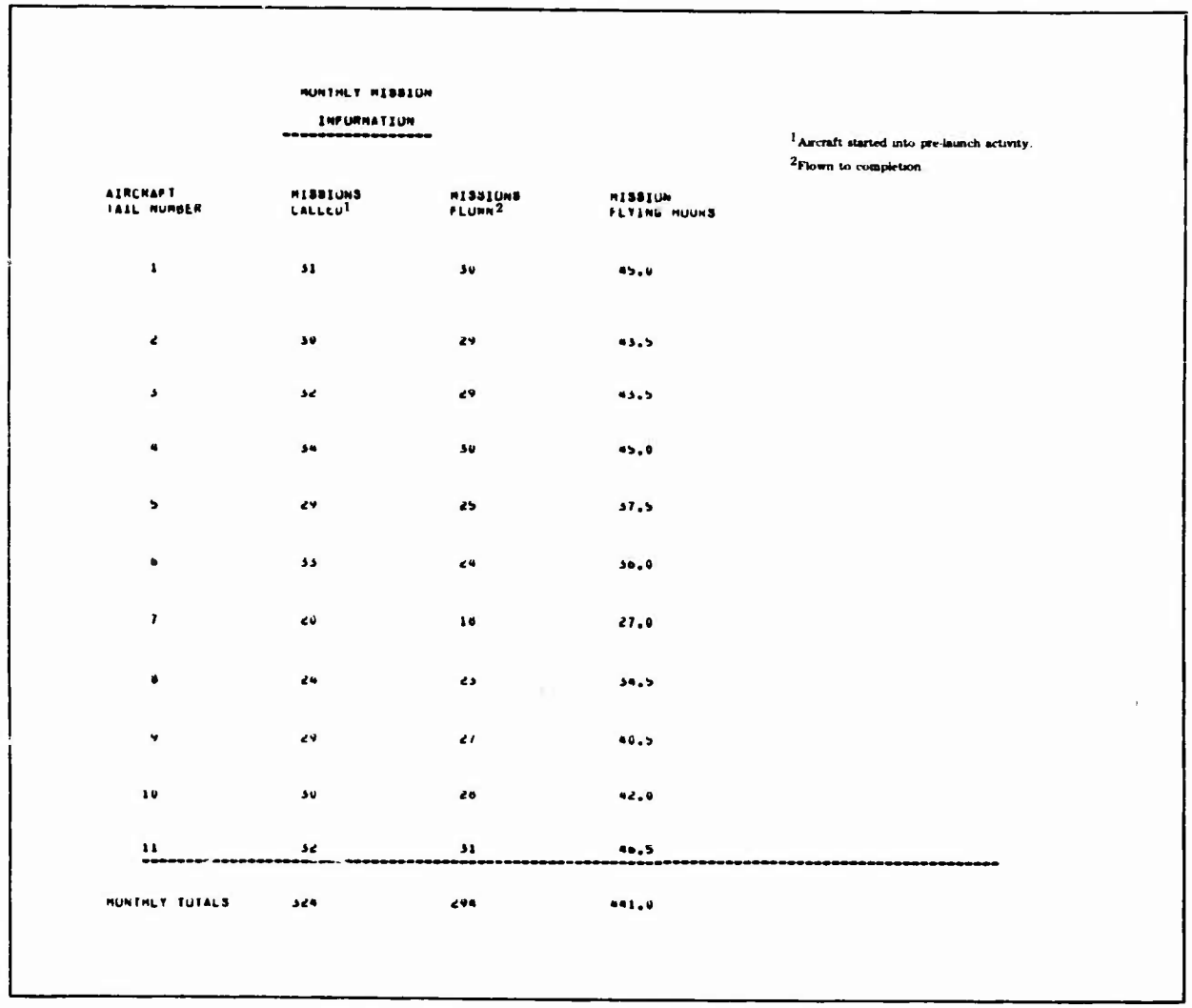
OFF EQUIPMENT COMPONENT MAINTENANCE MAY BE PERFORMED AT THE ORGANIZATIONAL, DIRECT SUPPORT OR GENERAL SUPPORT LEVELS IN THE FIELD.

CONDEMNATION OR NRTS STATUS ARE DECIDED UPON ONLY AT THE GENERAL SUPPORT LEVEL.

COMPONENT EVALUATED

CURRENT UH-1H MAIN ROTOR BLADE

Figure 9. Example of Output Editor.

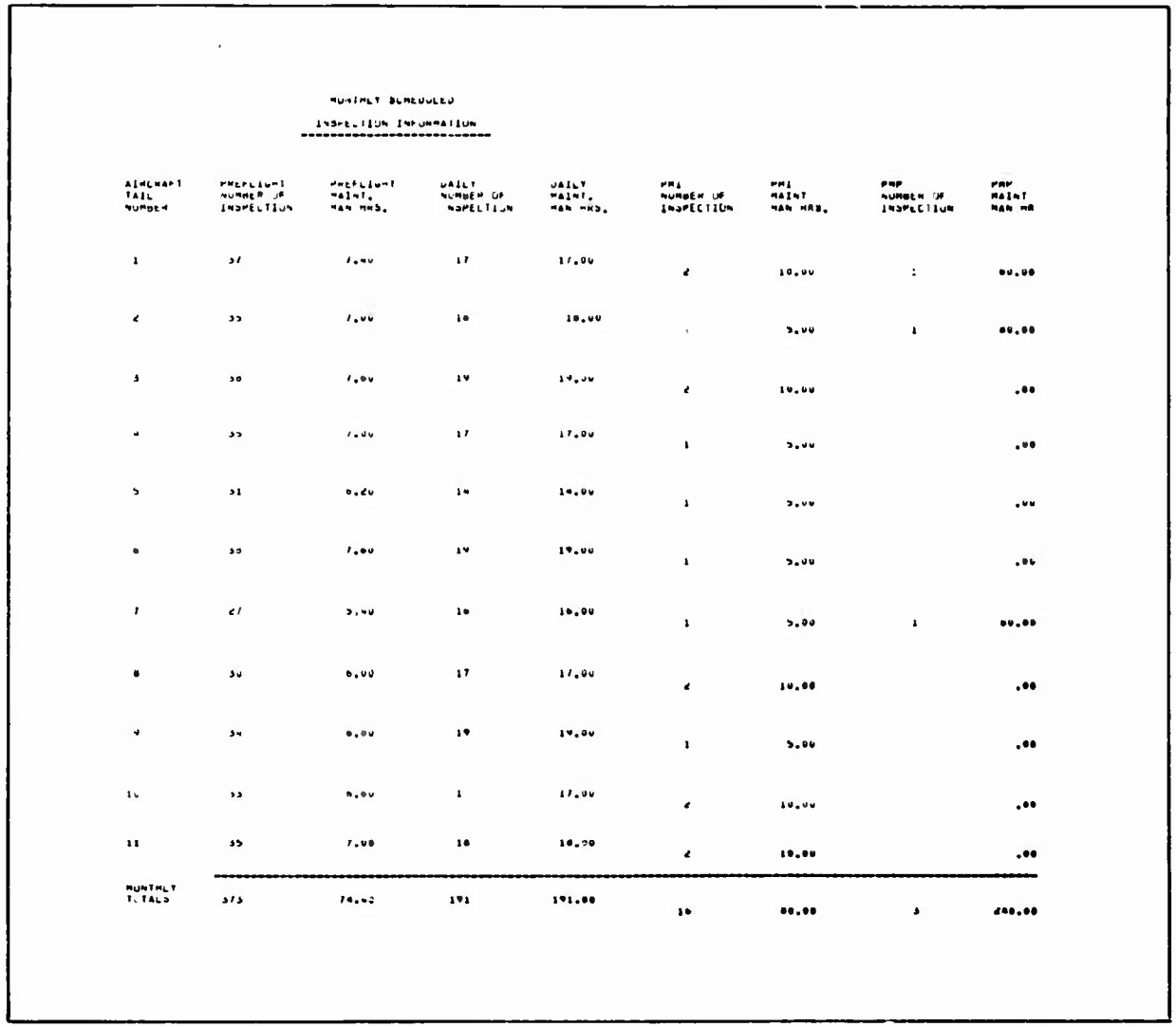


MONTHLY MISSION INFORMATION

[1] Aircraft started into pre-launch activity.
[2] Flown to completion

AIRCRAFT TAIL NUMBER	MISSIONS CALLED[1]	MISSIONS FLOWN[2]	MISSION FLYING HOURS
1	31	30	45.0
2	30	29	43.5
3	32	29	43.5
4	34	30	45.0
5	29	25	37.5
6	33	24	36.0
7	20	18	27.0
8	24	23	34.5
9	29	27	40.5
10	30	28	42.0
11	32	31	46.5
MONTHLY TOTALS	324	294	441.0

Figure 9. (continued).



MONTHLY SCHEDULED

INSPECTION INFORMATION

AIRCRAFT TAIL NUMBER	PREFLIGHT NUMBER OF INSPECTION	PREFLIGHT MAINT. MAN HRS.	DAILY NUMBER OF INSPECTION	DAILY MAINT. MAN HRS.	PMI NUMBER OF INSPECTION	PMI MAINT MAN HRS.	PMP NUMBER OF INSPECTION	PMP MAINT MAN HR
1	37	7.00	17	17.00	2	10.00	1	00.00
2	33	7.00	18	18.00	1	5.00	1	00.00
3	36	7.00	19	19.00	2	10.00		.00
4	33	7.00	17	17.00	1	5.00		.00
5	31	6.20	14	14.00	1	5.00		.00
6	36	7.00	19	19.00	1	5.00		.00
7	27	5.40	18	18.00	1	5.00	1	00.00
8	30	6.00	17	17.00	2	10.00		.00
9	34	6.80	19	19.00	1	5.00		.00
10	33	6.60	1	17.00	2	10.00		.00
11	35	7.00	18	18.00	2	10.00		.00
MONTHLY TOTALS	373	74.00	191	191.00	16	80.00	3	200.00

Figure 9. (continued).

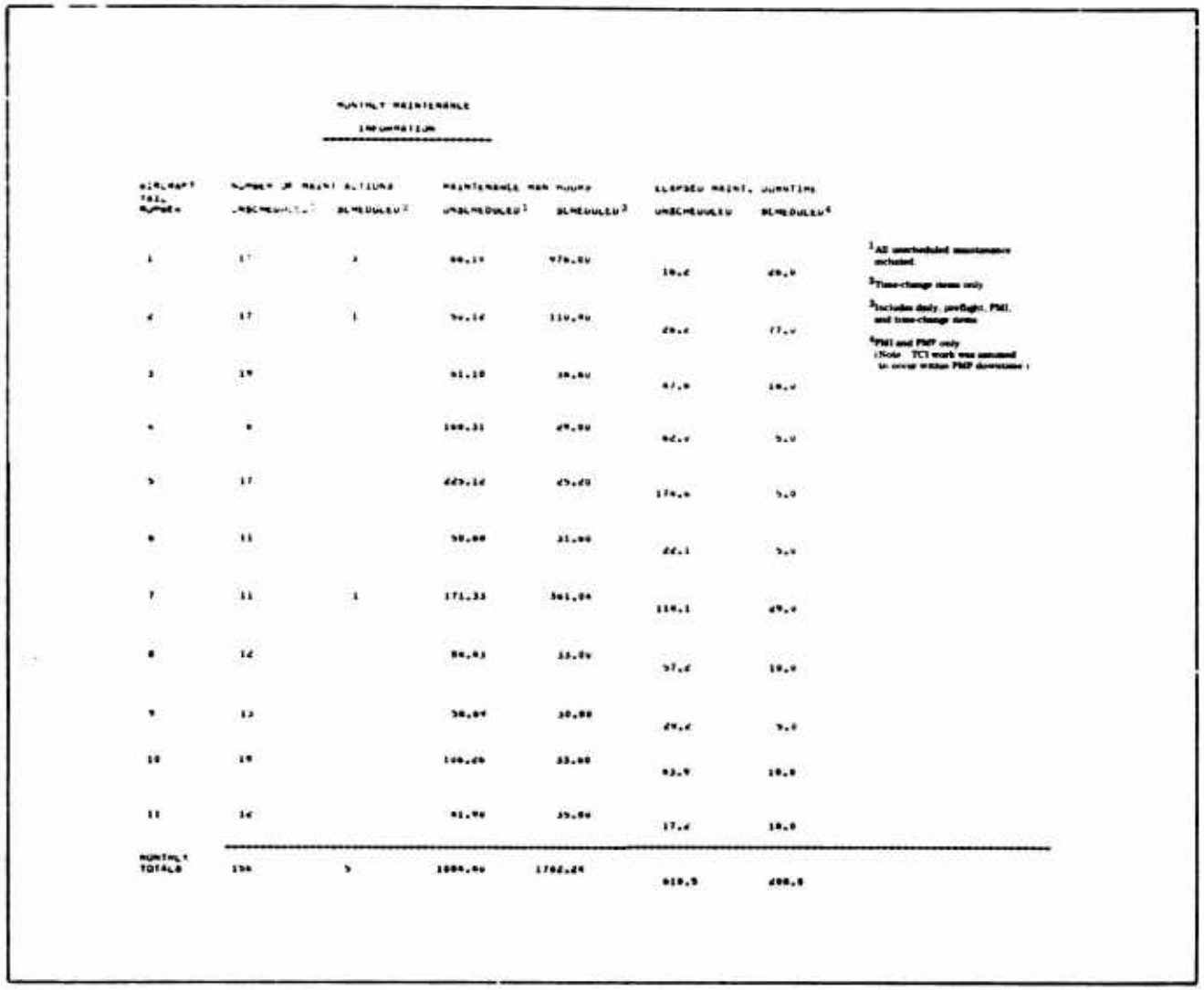


Figure 9. (continued).

MONTHLY AIRCRAFT CHARACTERISTICS

AIRCRAFT TAIL NUMBER	DIRECT MAINT. MAN HOURS PER FLIGHT HR.[1]	NOT OPERATIONALLY READY-MAINTENANCE[2]	NOT OPERATIONALLY READY-SUPPLY[2]	AVAILABILITY[3] UP TIME/TOTAL TIME[4]	MISSIONS FLOWN/MISSIONS CALLED[5]	MISSIONS COMP/MISSIONS CALLED[6]
1	20.43	42.2	.0	95.72	90.77	90.77
2	3.37	103.2	.0	84.64	90.66	90.66
3	1.97	63.8	.0	90.28	90.62	90.62
4	4.19	67.0	.0	90.02	88.83	88.83
5	6.33	179.6	.0	73.27	86.20	86.20
6	2.06	27.1	.0	95.96	72.72	72.72
7	17.17	143.1	.0	78.70	90.00	90.00
8	5.05	67.2	.0	90.00	95.83	95.83
9	2.10	34.2	.0	94.91	93.10	93.10
10	3.04	53.9	.0	91.97	93.33	93.33
11	1.92	35.2	.0	94.76	96.67	96.67
MONTHLY TOTALS	5.76	818.5	.0	88.92	90.74	90.74

[1] Total MH expenditures — including scheduled and unscheduled maintenance, on- or off-equipment, at O, D&, and G& levels.

[2] In hours.

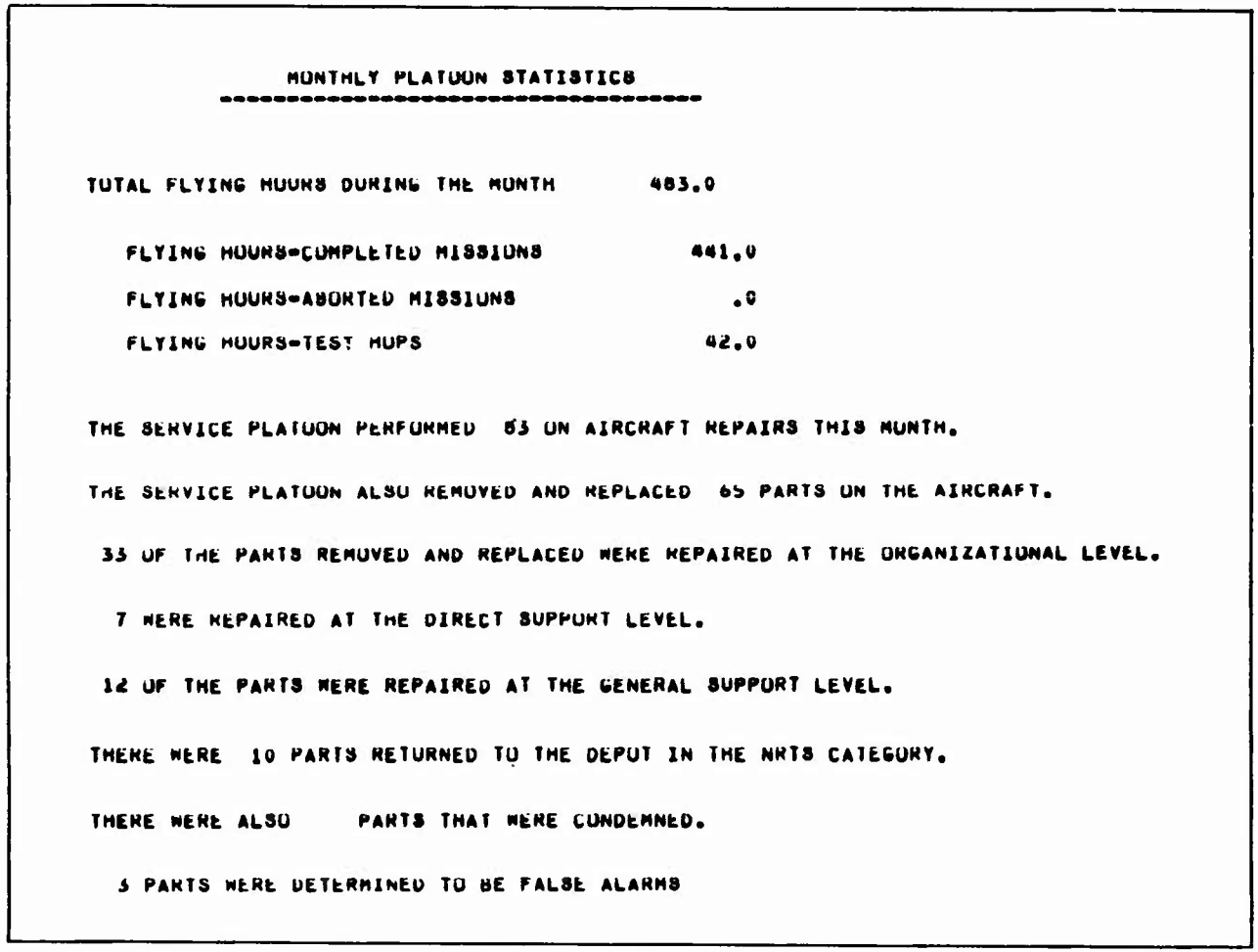
[3] In percent.

[4] Includes nonoperating uptime and nonactive in-work downtime.

[5] Aircraft starting flight. Aircraft starting prelaunch activities.

[6] Aircraft completing flight. Aircraft starting prelaunch activities.

Figure 9. (continued).



MONTHLY PLATOON STATISTICS

TOTAL FLYING HOURS DURING THE MONTH 483.0

FLYING HOURS-COMPLETED MISSIONS 441.0

FLYING HOURS-ABORTED MISSIONS .0

FLYING HOURS-TEST HOPS 42.0

THE SERVICE PLATOON PERFORMED 63 ON AIRCRAFT REPAIRS THIS MONTH.

THE SERVICE PLATOON ALSO REMOVED AND REPLACED 65 PARTS ON THE AIRCRAFT.

33 OF THE PARTS REMOVED AND REPLACED WERE REPAIRED AT THE ORGANIZATIONAL LEVEL.

7 WERE REPAIRED AT THE DIRECT SUPPORT LEVEL.

12 OF THE PARTS WERE REPAIRED AT THE GENERAL SUPPORT LEVEL.

THERE WERE 10 PARTS RETURNED TO THE DEPOT IN THE NRTS CATEGORY.

THERE WERE ALSO PARTS THAT WERE CONDEMNED.

5 PARTS WERE DETERMINED TO BE FALSE ALARMS

Figure 9. (concluded).

SAVEVALUES 185 and 186. Full-word SAVEVALUE 186 includes both scheduled and unscheduled downtime, as discussed previously in the Component-Relative-Ranking Technique section of this report.

The application of simulation modeling is most valuable as an analytic tool because it enables one to make estimates concerning the complex interactions at system, aircraft, and organization levels based on information known only at the basic component/element level. The best estimates of individual component R and M parameters are the data typically required as input to a simulation exercise; that is, as simulation time is increased, the approximation of individual component output (arrived at by using Monte Carlo techniques) will more closely approach the component values introduced as input. For this reason the component input data provide the most useful information for additional analysis related to the individual item.

Comparison of component input data with component data outputted by the simulation model is, in fact, a primary means of verifying model operation. Since the MRB was the component selected for the techniques-demonstration exercise, it was one of the components we used for model verification.

By using MRB input data from Appendix VI, comparisons can be made of expected and observed total component maintenance actions and removals and replacements in the flying hours represented by each six-month simulation (see Table VI).

TABLE VI. MRB MAINTENANCE EXPECTED AND OBSERVED THROUGH MAINTENANCE

MRB	Six-Month Simulation Flying Hours	Total Component MAs		Remove and Replace MAs	
		Expected (Rounded to Nearest Integer)	Observed	Expected (Rounded to Nearest Integer)	Observed
Baseline UH-1H	2926.5	4	4	3	3
Alternate I	2931.5	4	3	3	3
Alternate II	2951.9	4	3	3	3
Alternate III	2951.0	4	3	3	3
Alternate IV	2944.1	4	2	4	1

Two methods were used to verify that the simulation was a reasonable approximation of the real world. One was component checks, similar to those discussed above; the other method was comparison of outputted data, such as total direct-maintenance man-hours per flying hour, with actual rates experienced by the aircraft, as reflected in the input for the historical data period.

The summary shown in Table VII is a partial tabulation of platoon data resulting from the six one-month simulation runs conducted with each MRB configuration installed.

TABLE VII. PARTIAL TABULATIONS OF PLATOON DATA

Data Item	Simulation Month						Six-Month Average
	1	2	3	4	5	6	
Baseline, UH-1N With UH-1H MRB							
Unscheduled MAs	153	156	197	179	186	190	177
Flying Hours	494.2	483	486.1	490.6	489.7	482.9	487.7
DMMH/FH	2.75	5.76	4.25	3.25	3.77	4.37	4.025
Uptime/Total Time (Percent)	89.96	88.92	89.31	92.74	90.33	89.25	90.085
ircraft Flown/Aircraft Called (Percent)	92.54	90.74	91.61	92.26	91.15	90.76	91.510
1A/FH (Unscheduled)							0.3629
UH-1N With Alternate I MRB							
Unscheduled MAs	168	167	138	175	163	182	165.5
Flying Hours	496.4	484.7	491.6	486.9	483.2	488.7	488.6
DMM/FH	2.66	4.12	2.54	4.01	3.38	3.92	3.438
Uptime/Total Time (Percent	90.73	86.82	91.73	90.36	93.73	90.41	[illegible]
Aircraft Flow n/Aircraft Called (Percent)	93.75	91.10	94.33	91.27	92.21	92.5[illegible]	
MA/FH (Unscheduled)							
UH-1N With Alternate II MRB							
Unscheduled MAs	164	159	168	179	164	194	[illegible]
Flying Hours	493.7	489.7	487.6	495.0	496.4	489.5	491.9
DMMH/FH	3.21	3.46	2.71	5.93	2.98	3.23	3.926
Uptime/Total Time (Percent)	90.26	86.90	91.50	85.87	93.37	88.83	89.45
Aircraft Flow/Aircraft Called (Percent)	92	94.62	93.75	91.13	94.63	91.66	92.97
MA/FH (Unscheduled)							0.3482
UH-1N With Alternate III MRB							
Unscheduled MAs	160	160	169	193	17[illegible]	179	172.3
Flying Hours	495.2	492.7	485.2	491.2	491.7	495.0	491.8
DMMH/FH	4.71	4.34	5.30	4.54	3.82	4.07	4.463
Uptime/Total Time (Percent)	89.13	89.75	88.91	85.79	89.51	89.80	88.81
Aircraft Flow/Aircraft Called (Percent)	92.59	93.47	92.21	92.50	92.00	93.12	92.65
MA/FH (Unscheduled)							0.3503
UH-1N With Alternate IV MRB							
Unscheduled MAs	171	158	175	193	154	176	171
Flying Hours	489.4	489.7	494.8	495.2	489.7	485.3	490.7
DMMH/FH	3.81	4.54	2.76	6.44	2.89	3.22	3.94
Uptime/Total Time (Percent)	86.53	92.10	92.11	86.76	92.84	92.82	90.53
Aircraft Flow/Aircraft Called (Percent)	92.26	93.73	92.59	92.59	92.28	92.28	92.62
MA/FH (Unscheduled)							0.348

As indicated in the Component-Relative-Ranking Technique section of this report, the recommended (and most comprehensive) measure of the impact of different component R and M characteristics on the balance of the aircraft is the effect that the component change has on aircraft availability. Unless the differences in R and M characteristics resulting from the component change (or other changes that might be evaluated by using O and M simulation) are significant relative to the characteristics of the overall system/aircraft, however, impact on aircraft availability can be of such magnitude as to be lost in the random variability inherent in many simulation models.

In any case, it is advantageous for a person conducting evaluation exercises, such as that performed, to develop a separate estimate of the impact so that decisions can be made about such aspects as the reasonableness of expectations about simulation-model discrimination and the possible advantages of increasing the length of simulation.

In the MRB exercise, the separate estimate was made by using baseline and alternate MRB component input data (see Appendix VI) and baseline configuration simulation results. This estimate is summarized in Table VIII.

TABLE VIII. RESULTS OF SEPARATE ESTIMATE, MRB EXERCISE

Calculation Elements*	Baseline UN-1H	Alt. I	Alt. II	Alt. III	Alt IV
Probability of Removal and Replacement	.856	.789	.841	.817	.929
Remove and Replace MEMT (Hours)	3.7	3.7	3.7	3.7	3.7
Repair MEMT (Hours)	2.3	2.0	2.9	2.1	5.2
Average MEMT for An On-Aircraft MA (Hours)	3.464	3.341	3.573	3.590	3.806
Expected MAs in Six-Month Simulation	4	4	4	4	4
Total Expected On-Aircraft EMT in Six-Month Simulation (Hours)	13.856	13.364	14.292	14.360	15.224
Difference in EMT Compared with Baseline	0	-0.492	+0.436	+0.504	+1.368

*For determining expected differences in EMT compared with the baseline.

If the equation Availability = $\frac{\text{Uptime}}{\text{Total Time}}$ is used, the uptime hours in the six months of baseline system operation can be determined by

$$\text{Uptime}_{\text{Baseline}} = A_{\text{Baseline}} * \text{Total Time}$$

or

$$\text{Uptime}_{\text{Baseline}} = 0.90085*6*672*11 = 39{,}954.499 \text{ hours}$$

- 11 — aircraft in platoon
- 672 — hours/month
- 6 — months

By using the expected differences in EMT compared with the baseline, expected operational availabilities based on uptime-to-total-time ratios can be determined for the alternate-configuration systems:

$$A_I = \frac{39{,}954.499 - (-0.492)}{44{,}352} = 0.90086$$

$$A_{II} = \frac{39{,}954.499 - (+0.436)}{44{,}352} = 0.90084$$

$$A_{III} = \frac{39{,}954.499 - (+0.504)}{44{,}352} = 0.90084$$

$$A_{IV} = \frac{39{,}954.499 - (+1.368)}{44{,}352} = 0.90082$$

Similar analysis applied to the baseline simulation result of 0.4123 for intrinsic availability, as described in the following subsection (Part 4: Component Relative Ranking, Job 12, RANKTAB), results in determinations of alternate-system intrinsic availabilities of 0.4124, 0.4123, 0.4122, and 0.4121 when alternate MRBs I through IV are installed, respectively.

On the basis of these analyses, operational availability was not expected to be affected by the MRB change above the fifth decimal point, and intrinsic availability was not expected to be affected above the fourth decimal point. Changes of such a small magnitude are not normally detectable by simulation techniques, even with large increases in computer running times.

Comparison of the theoretical effects of making the MRB changes and the subsequent simulation results (with the alternate MRBs installed) indicates that the variations in simulations tend to mask such relatively minor hardware adjustments (see Table IX).

TABLE IX. COMPARISON OF EXPECTED AND SIMULATION RESULTS FOR AVAILABILITY AND RANKING

Aircraft With MRB	Expected		Simulation Result	
	Operational Availability	Relative Ranking	Operational Availability	Relative Ranking
Baseline UH-1H	0.90085	2	0.90085	3
Alternate I	0.90086	1	0.9063	1
Alternate II	0.90084	3	0.8945	4
Alternate III	0.90084	4	0.8881	5
Alternate IV	0.90082	5	0.9053	

The foregoing conclusions were further confirmed by statistical analysis using the following baseline simulation results:

Average Operational Availability	= 0.90085
Total Downtime in Six-Month Simulation (including downtime in off-hours)	= 4,898 hours
Total Uptime in Six-Month Simulation (including uptime when not operating)	= 39,954 hours
Average Intrinsic Availability	= 0.4123
Total In-Work Downtime in Six-Month Simulation	= 4395.2 hours
Total Operating Time (Flying Hours) in Six-Month Simulation	= 2926.5 hours
Total Downing Events (Scheduled or Unscheduled) in Six-Month Simulation	= 703

Using these data from the baseline simulation, and assuming an exponential distribution of times to downing events and downtimes, it is possible to compute a 95-percent confidence interval for the availability of the system with the procedure defined in Reference 3. This interval can be interpreted as a significance test for subsequent simulation runs; that is, if the point estimate of availability for a subsequent simulation run falls within this interval, it can be stated that the data do not indicate that the results of the two runs are different with respect to availability.

To compute the confidence interval for availability, using the noted reference, the following relationships were used:

The upper (U) and lower (L) confidence limits of a confidence interval about $\frac{\hat{\phi}}{\hat{\theta}}$ can be obtained by

$$\left(\frac{\phi}{\theta}\right)_U = \frac{n}{n-1}\,\frac{\hat{\phi}}{\hat{\theta}}\,F_{\frac{1-a}{2};\,2n,\,2n}$$

$$\left(\frac{\phi}{\theta}\right)_L = \frac{n}{n-1}\,\frac{\hat{\phi}}{\hat{\theta}}\,F_{\frac{a}{2};\,2n,\,2n}$$

where

n	= the number of downing events plus one
$1-a$	= the level of confidence
$F_{\frac{1-a}{2};\,2n,\,2n}$	= the upper $\frac{1-a}{2}$ fractile of the cumulative F density with 2n and 2n degrees of freedom
$F_{\frac{a}{2};\,2n,\,2n}$	= the lower $\frac{a}{2}$ fractile of the cumulative F density with 2n and 2n degrees of freedom
$\hat{\theta}$	= uptime or operating time, as appropriate
$\hat{\phi}$	= downtime or in-work repair times, as appropriate

If availability is expressed as

$$A = \frac{1}{1+\left(\frac{\phi}{\theta}\right)}$$

then the upper and lower limits of a confidence interval may be obtained from the following relations:

$$A_U = \frac{1}{1+\left(\frac{\phi}{\theta}\right)_L}$$

$$A_L = \frac{1}{1+\left(\frac{\phi}{\theta}\right)_U}$$

The 95-percent confidence interval for the average baseline operational availability of 0.90085 was determined, by using the above relationships, to be $A_L = 0.8905$ and $A_U = 0.9097$. Since three of the four point estimates of operational availability from subsequent simulation runs, with alternate MRBs, fell within the approximate two-percent interval, it can be stated that each (of the three point estimates) did not differ from the baseline with respect to availability. In any case, it is seen that the confidence interval about the baseline operational availability well encompasses the effects on availability previously estimated for the MRB changes. The 95-percent confidence interval for the baseline intrinsic availability of 0.4123, $A_L = 0.3869$ and $A_U = 0.4374$ also well encompasses the MRB change effects on intrinsic availability previously noted.

On the basis of the foregoing analysis of simulation results, the demonstration exercise for technique development was continued as indicated in the following subsection (Component Relative Ranking, Job 12, RANKTAB).

In each application of the simulation model, the results should be evaluated by the investigator in a manner that will be most meaningful (the evaluations described were selected for their relevance to the demonstration exercise) in formulating decisions about such aspects as increasing simulation time and modifying simulation data-collection approaches.

The scenario utilized for this exercise included the assumption of unlimited parts and manpower. Thus maintenance downtimes were short—approximately equal to mean time to repair. Because of this, there was little carry-over of maintenance from day to day, and it was decided to collect data beginning on the first day of the simulation (without a start-up period). If the R&M model is utilized in a scenario involving considerable long-term maintenance downtime (for example, long periods of waiting for parts), the analyst should consider running the model for some time prior to beginning data recording in order to achieve a steady-state operational stability in the organization being simulated.

Also, a six-month period was chosen as the simulated operational interval for each case considered. This was sufficient for the current exercise. Revised scenarios or different analyses may require more or fewer operational data. The analyst must consider the period of time simulated in the context of his particular experiment.

Additional information concerning the simulation model is provided in a separately submitted computer-software package.

PART 4: COMPONENT RELATIVE RANKING, JOB 12, RANKTAB

Job 12 has one step, COMPRANK. The data elements involved in the input to COMPRANK, the logic included in the program, and the output are discussed in detail in the previous Component-Relative-Ranking Technique section.

A listing of typical component-data-card input to COMPRANK is presented in Figure 10. There are 64 data inputs required for each component configuration included in the relative-ranking process. In addition, the interest rate that is to be used in differential-cost discounting to "Present Value" and the desired probability of a spare's being available when needed are inputs required on the last data card. COMPRANK calculates internally another 20 data inputs (P4, P5, P8, P10, P11, P12, P13, MR2, MR3, MR4, HR1, HR2, HR3, HR4, YD, YP, YO, FHR, LCFH, and DR), which are used in the relative-cost ranking formula.

The investigator applying COMPRANK in an actual component analysis task must determine the effort that will be devoted to development and purification of the various probability,

```
                5                                                       NCOMP
.789        .841        .817        .929        .831                    P1
.0          .0          .0          .0          .0                      P2
.0          .0          .0          .0          .0                      P3
.515        .480        .532        .478        .872                    P6
.739        .700        .756        .697        .939                    P7
.0          .0          .0          .0          .0                      P9
.357        .310        .379        .308        .831                    P14
.107        .103        .155        .123        .169                    P15
.0          .0          .0          .0          .0                      P16
.250        .207        .224        .185        .662                    P17
1.          1.          1.          1.          1.                      T1
1.          1.          1.          1.          1.                      T2
2.          2.          2.          2.          2.                      T3
2.          2.          2.          2.          2.                      T4
2.          2.          2.          2.          2.                      T5
2.          2.          2.          2.          2.                      T6
30.         30.         30.         30.         30.                     T7
120.        120.        120.        120.        120.                    T8
4.          4.          4.          4.          4.                      C1
4.          4.          4.          4.          4.                      C2
4.          4.          4.          4.          4.                      C3
12.         12.         12.         12.         12.                     C4
18.         18.         18.         18.         18.                     C5
18.         18.         18.         18.         18.                     C6
90.         90.         90.         90.         90.                     C7
56.         56.         53.         70.         5.                      C8
56.         56.         53.         76.         5.                      C9
56.         56.         53.         76.         5.                      C10
56.         56.         53.         76.         5.                      C11
0.          0.          0.          0.          0.                      C12
5000832.    5014116.    5001760.    5011178.    5000000.                C13
5000000.    5000000.    5000000.    5000000.    5000000.                C14
3320.       9962.       3784.       8493.       2904.                   C15
2904.       2904.       2904.       2904.       2904.                   C16
0.          0.          0.          0.          0.                      C17
958056.     1437084.    1437084.    1515065.    958056.                 C18
798.        798.        798.        798.        798.                    C19
200.        200.        200.        200.        200.                    C20
.4123       .4123       .4123       .4123       .4123                   A1
.4124       .4123       .4122       .4121       .4123                   A2
2.          2.          2.          2.          2.                      Q1
500.        500.        500.        500.        500.                    Q2
500.        500.        500.        500.        500.                    AUR
260.        260.        260.        260.        260.                    FDR
1.          1.          1.          1.          1.                      SD
2.          2.          2.          2.          2.                      CD
3.          3.          3.          3.          3.                      SP
5.          5.          5.          5.          5.                      CP
4.          4.          4.          4.          4.                      SD
13.         13.         13.         13.         13.                     CD
.00142      .00138      .00142      .00140      .00142                  MR1
1.          1.          1.          1.          1.                      PDS

2.0         2.9         3.1         5.2         2.3                     MT1
3.7         3.7         3.7         3.7         3.7                     MT2
4.5         4.0         4.3         5.0         1.6                     MT31
4.5         4.0         4.3         5.0         1.6                     MT32
4.5         4.0         4.3         5.0         1.6                     MT33
4.5         4.0         4.3         5.0         1.6                     MT34
.3          .3          .2          .3          .2                      MP1
2.          2.          2.          2           2.                      MP2
1.          1.          1.          1.          1.                      MP31
1.          1.          1.          1.          1.                      MP32
1.          1.          1.          1.          1.                      MP33
1.          1.          1.          1.          1.                      MP34
.1          .90                                                         IR,PS
```

Figure 10. Case 1 Input Data to COMPRANK — Job 12, Step 1.

logistics-cycle, cost, and system operating data. The various changes in specific input parameters, or sets of input parameters, that might be made by the investigator to test effects on component R and M ranking are unlimited. Just as with the simulation model, the component-relative-ranking model can be used alone or in combination in the overall technique described herein to provide an analysis tool supporting many aspects of R and D program management.

The input parameters shown in Figure 10 represent data related to the MRB concepts used for demonstration purposes in the technique-development program. Reading from left to right, the columns input alternate I, alternate II, alternate III, alternate IV, and current UH-1H (C) MRB related data. Many of the inputs related to logistic-pipeline times, costs (maintenance man-hour rates, unit-shipping, etc.), mission operating requirements, and life-cycle periods are applied uniformly to all candidate components.

R and M data related to specific MRB configurations were derived directly or calculated from information previously developed (through analysis of Reference 1) during preparation of the simulation-model input (see Appendix VI). Most of the other parameters were also derived from Reference 1. However, where Reference 1 did not contain needed data elements, such as logistic-pipeline parameters related to component processing between O, DS, and GS levels of Army maintenance, estimates were made on the basis of our earlier program discussions with helicopter-support personnel at Fort Bragg, or the reasonableness of the input for technique-demonstration purposes.

Aircraft-availability inputs — A1 for baseline-configured aircraft and A2 for aircraft configured with alternate MRBs — are developed through the simulation model. As discussed in the Component-Relative-Ranking Technique section, the expression for availability recommended for use in component ranking is that of intrinsic availability defined by the expression

$$A = \frac{MFHBDE_{Unsched + Sched\ (PMI\ and\ PMP)}}{MFHBDE_{Unsched + Sched} + MEMT_{Unsched + Sched}}$$

Also discussed was the point that the investigator may have to mathematically calculate alternate-aircraft-configuration availabilities from the baseline-aircraft availability, determined with the simulation model, when relatively low-failure-rate and low-maintenance-expenditure components are being considered. Statistical tests completed on the simulation model by the RAIL Company indicate that availability differences over a range of about two percent cannot be considered significant in the simulation output. In cases where the component change is not sufficient to cause identifiable changes in simulation output, the investigator must decide whether to bypass the part of the ranking involving component impact on availability, making A2 equal A1 in the input, or to proceed to derive the alternate configuration A2's mathematically.

In the MRB demonstration exercise, it was determined that on the basis of mean component R and M data the effect of alternate MRB configurations on aircraft availability would not be noticeable above the fourth decimal place. The mathematical approach was therefore used for demonstration purposes in the exercise as follows:

1. Simulation baseline configuration runs were completed with the UH-1H (C) MRB installed in the UH-1N helicopter, and A1 was determined to equal 0.4123.

2. Assuming independence of the component (MRB) from the balance of the aircraft, $A1 = A_{s-c} * A_c$. A_c is determined by an expression similar to that used in the simulation output for aircraft availability, that is,

$$A_c = \frac{MFHBMA_c}{MFHBMA_c + MEMT_c}$$

or (from the MRB-input parameters previously developed and shown in Figure 9)

$$A_c = \frac{\frac{1}{MR1}}{\frac{1}{MR1} + [(P1*MT2) + (1 - P1)*MT1]}$$

Therefore, the baseline MRB is

$$A_{cC} = \frac{\frac{1}{0.00142}}{\frac{1}{0.00142} + (0.831*3.7) + (0.169*2.3)}$$

or 0.9951. From the expression for $A1_C$, $A_{s-c} = \frac{A1_C}{A_{cC}}$ or $\frac{0.4123}{0.9951}$. Therefore, $A_{s-c} = 0.4143$.

3. A2's for the aircraft with alternate MRBs I, II, III, and IV installed can be calculated by using the expression $A2 = A_{s-c} * A_{ci}$ (A2 equals A1 for the baseline MRB C input):

$$A2_I = 0.4143* \frac{\frac{1}{0.00142}}{\frac{1}{0.00142} + (0.789*3.7) + (0.211*2.0)} = 0.4124$$

$$A2_{II} = 0.4143* \frac{\frac{1}{0.00138}}{\frac{1}{0.00138} + (0.841*3.7) + (0.183*2.9)} = 0.4123$$

$$A2_{III} = 0.4143* \frac{\frac{1}{0.00142}}{\frac{1}{0.00142} + (0.817*3.7) + (0.183*3.1)} = 0.4122$$

$$A2_{IV} = 0.4143^* \frac{\frac{1}{0.00140}}{\frac{1}{0.00140} + (0.929^*3.7) + (0.071^*5.2)} = 0.4121$$

Six runs of COMPRANK were completed in the demonstration MRB ranking exercise. The resulting life-cycle cost and ranking tables are included in Appendix VIII. The component rankings are based on the tabulations of Total Discounted Differential Life-Cycle Effective Cost Influence (ECI) in the last table of each run. Alternate MRBs I, II, III, and IV are identified as 1, 2, 3, and 4 in the tables; the current UH-1H MRB is identified as 5.

Input data as shown in Figure 10 were used in each run, except as follows:

Case	Description of Input Data
1	No change
2	Number of aircraft in fleet, Q2, changed from 500 to 1,000
3	Number of aircraft in fleet, Q2, changed from 500 to 2,000
4	Interest rate, IR in input, changed from 0.1 to zero
5	Cost of alternate MRBs, $C15_{1,2,3, \text{ and } 4}$, increased 10 percent (with commensurate change in C13)
6	Damage rate, MR1, increased 10 percent for all MRBs

MRB rankings are based on decreasing preference with increasing ECI. Since the ECI results are (by design) not representative of total life-cycle component cost but instead represent differential component related costs, the results can be analyzed further by (for example) determining the additional cost per aircraft related to each configuration in comparison with the top-ranking MRB configuration.

The results of each case are summarized in Table X. An investigator may wish to perform further analysis in a variety of directions; for example, component unit-cost break points might be determined, effects of different failure rates investigated, etc.

(Note: The spare-component totals printed under the ECIs in each case in Appendix VIII are the spares to fill all of the described pipelines initially on the basis of a 90-percent probability of having a spare when required, PS.)

TABLE X. RESULTS OF MAIN ROTOR BLADE CONFIGURATION RANKING

Case	Ranking Order	Additional Cost Per Aircraft Compared With Top-Ranked MRB (Dollars)	Percent Change in Additional Cost Per Aircraft for Changes in Case-Data from Case 1
1	I (1)*		
(See Figure 9)	III (3)	3,667	
	C (5)	4,107	
	IV (4)	14,980	
	II (2)	16,060	
2	I		
Increase fleet size 100%, from 500 to 1,000 aircraft	III	3,202	12.7% decrease
	C	4,101	0.1% decrease
	IV	14,428	3.7% decrease
	II	15,578	3.0% decrease
3	I		
Increase fleet size 300%, from 500 to 2,000 aircraft	III	2,973	18.9% decrease
	C	4,095	0.3% decrease
	IV	14,146	5.6% decrease
	II	15,328	4.6% decrease
4	I		
Decrease interest rate to zero % (remove discounting to "Present Value")	III	4,721	28.7% increase
	C	7,669	86.7% increase
	IV	21,466	43.3% increase
	II	23,434	45.9% increase
5	I		
Increase cost of alternate MRBs I, II, III, and IV 10%	C	3,340	18.7% decrease
	III	3,756	2.4% increase
	IV	16,067	7.3% increase
	II	17,484	8.9% increase
6	I		
Increase all MRB damage rates 10%	III	3,682	0.4% increase
	C	4,481	9.1% increase
	IV	15,324	2.3% increase
	II	16,489	2.7% increase

*Numbers in parentheses correspond to computer ranking ir Appendix VIII.

CONCLUSIONS

The analysis technique developed in this program will facilitate the Army's tasks of estimating the impact of predicted component reliability and maintainability on an aircraft system and evaluating and ranking competing components on the basis of their R and M characteristics.

There are many possible variations in application of the technique, for example:

- The algorithm can be exercised in full to use Navy aircraft source data for input to an Army O and M simulation, followed by component-ranking determination.
- Army or Air Force aircraft data can be adapted to a point in the algorithm that will permit GPSS function calculation and continuation through simulation and component ranking.
- An aircraft can be fabricated (in terms of data) from various sources and used as a "composite" baseline vehicle in the algorithm.
- The simulation model can be used separately to assist in performing various aircraft O and M concept trade-off analyses.
- The special component-ranking model can be used separately to compare component R and M characteristics (omitting the impact on total aircraft availability) and to support any number of component cost, reliability, and maintenance-concept trade-off analyses.

Applications of all or portions of the technique described are limited only by the imagination of the investigator and the opportunities that occur.

In the component evaluation exercise using main rotor blades, the alternate component R and M characteristics were not sufficiently different to affect simulation-model output significantly. In any application of the simulation model involving testing of alternate equipments or O and M concepts, preliminary estimates of the discrimination needed or desired in the model output should be made and sensitivity tests should be run for particular scenarios and systems to establish a level of confidence in the results.

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APPENDIX I
MAINTENANCE-ACTION FILE FORMAT

The following record description defines the layout and content of the 3-M maintenance action (MA) files outputted from Job 3, Step 3, in the Aircraft Historical Data Tabulation portion of the component evaluation and ranking algorithm.

The series of program steps in Job 3 process data from the various 3M-MDCS card types, as indicated in the record description, into a composite record of the MA.

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
I. BASIC JOB IDENTIFICATION				
Job Control:				
1. Organization Initiating Action	1-3	L1 or L2-11,12,16,17,21,26 27,31,32,34,41,46,47	1-3 (AN)	(1)
2. Date Action Was Initiated	4-7	L1 or L2-11,12,16,17,21,26, 27,31,32,34,41,46,47	4-7 (N)	(1)
3. Serial No. of Action	8-10	L1 or L2-11,12,16,17,21,26, 27,31,32,34,41,46,47	8-10 (AN)	(1)
4. Suffix	11	31, L2-11s,L2-12s,32,34,	11 (AN)	(1)
5. Original Document Designator	12-13	Any Card Used for D.E. 1-4	79-80 (N)	(2)
6. Type Equipment	14-17	Same as for D.E.5, but not 34s	12-15 (AN)	(1),(3)
7. BUNO/Serial No. of Aircraft	18-23	Same as for D.E.5, but not 34s	16-21 (AN)	(1),(3)
II. LEVEL-1, PRIMARY WORK CENTER DATA FOR END ITEM, OR SYSTEM, ACTIONS				
8. Action Organization, Level 1	24-26	L1-11,12,16,17,21,26,27,41, 46,47	22-24	(1),(4)
9. Work Center, Level 1	27-29	L1-11,12,21,41,46,47	25-27 (AN)	(4A)
10. Action Date at Level 1	30-33	L1-11,12,16,17,21,26,27,41, 46,47	29-32 (N)	(4B)
11. Date of Completion of Calendar Inspection	34-37	L1-11s only	29-32	(4C)
12. Work Unit Code, System or LRU	38-44	L1 or L2-11,12,16,17,21,26, 27,31,32	33-39 (AN)	(1),(3A)
13. When Discovered Code, Level 1	45	L1 or L2-11,12,21,31,32	40 (AN)	(1),(3A)
14. Type Maintenance Code, Level 1	46	L1 or L2-11,12,21,31,32	41 (A)	(1),(3A)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
15. Action Taken at Level 1	47	L1-11,16,17,21,26,27	42 (AN) on 11, 21 25 (AN) on 16, 17,26,27	(4D)
16. Malfunction Code, Level 1	48-50	L1-11,16,17,21,26,27	43-45 (N) on 11,21, 26-28 (N) on 16,17,26,27	(4B)
17. Items Processed, Level 1	51-52	L1-11,21,41	46-47 (N)	(4A)
18. Man-Hours, Level 1	53-56	L1-11,21,41	48-51 (N)	(4B)
19. Elapsed Maintenance Time, Level 1	57-59	L1-11,12,41	52-54 (N)	(4B)
20. System or LRU Reference Designator Code	60-62	None	None	(8)
Removed Items (LRU or System Parts From Systems) - Level 1 Repairs				
21. MFG. of Cannibalized Item Removed, Level 1	63-67	L1-11, or 16	55-59(AN) on 11 40-44(AN) on 16	(9)
22. MFG. of Item Removed to be Replaced, Level 1	68-72	16,26,31	40-44(AN) or 16 & 26 55-59(AN) on 31	(10)
23. Serial Number of Removed Item, Level 1	73-82	16,26,34	45-54(AN) on 16 & 26 12-21(AN) on 34	(10A)
24. Part Number of Cannibalized Item, Level 1	83-97	L1-11,16	60-74(AN) on 11	(9)
25. Part Number of Removed Item, Level 1	98-112	16,26,31	55-69(AN) on 16 & 26	(10)
26. Time/Cycle of Removed Item, Level1	113-117	16,26,34	70-74(AN) on 16 & 26 22-26(AN) on 34	(10A)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
27. System Configuration Baseline Code for Removed Items	118-121	None	None	(14)
28. Type Number for Removed Item	122-128	None	None	(13)
29. Configuration of Syste[illegible]ked on and Reference Designat[illegible] for Removed Item	129-140	None	None	(15)
Installed Items (LRU or System Parts into System) - Level 1 Repairs				
30. MFG. of Item Installed After Cannibalization, Level 1	141-145	17 only	40-44 (AN)	(11)
31. MFG. of Installed Item, Level 1	146-150	17, 27	40-44 (AN)	(12)
32. Serial No. of Installed Item, Level 1	151-160	17, 27	45-54 (AN)	(12A)
33. Part No. of Installed Item After Cannibalization, Level 1	161-175	17 only	55-69 (AN)	(11)
34. Part No. of Installed Item, Level 1	176-190	17, 27	55-69 (AN)	(12)
35. Time/Cycle on Installed Item, Level 1	191-195	17, 27	70-74 (AN)	(12A)
36. System Configuration Baseline Code for Installed Item	196-199	None	None	(14A)
37. Type Number for Installed Item	200-206	None	None	(13A)
38. Reference Designator for Installed Item	207-215	None	None	(15A)
Failed Material from Level 1 Repairs of Systems				
39. Action Taken on Failed Material (1st Line Item on MAF Block 40)	219	L1-12 only	42(A)	(16)
40. Malfunction Code on Failed Material (1st Line Item on MAF Block 40)	220-222	L1-12 only	43-45 (AN)	(16)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
41. Quantity of Failed Material (1st Line Item on MAF Block 40)	223-224	L1-12 only	46-47 (N)	(16)
42. Manufacturer of Failed Material (1st Line Item on MAF Block 40)	225-229	L1-12 only	55-59 (AN)	(16)
43. Part Number/Reference Symbol of Failed Material (1st Line Item on MAF Block 40)	230-244	L1-12 only	60-74 (AN)	(16)
44. ARINC Research Failed Material Code (1st Line Item on MAF Block 40)	245-248	None	None	(17)
45. Action Taken on Failed Material (2nd Line Item on MAF Block 40)	249	L1-12 only	42(A)	(16)
46. Malfunction Code on Failed Material (2nd Line Item on MAF Block 40)	250-252	L1-12 only	43-45 (AN)	(16)
47. Quantity of Failed Material (2nd Line Item on MAF Block 40)	253-254	L1-12 only	46-47 (N)	(16)
48. Manufacturer of Failed Material (2nd Line Item on MAF Block 40)	255-259	L1-12 only	55-59 (AN)	(16)
49. Part No./Ref. Symbol of Failed Material (2nd Line Item on MAF Block 40)	260-274	L1-12 only	60-74 (AN)	(16)
50. ARINC Research Failed Material Code (2nd Line Item on MAF Block 40)	275-278	None	None	(17)
51. Action Taken on Failed Material (3rd Line Item on MAF Block 40)	279	L1-12 only	42 (A)	(16)
52. Malfunction Code on Failed Material (3rd Line Item on MAF Block 40)	280-282	L1-12 only	43-45 (AN)	(16)
53. Quantity of Failed Material (3rd Line Item on MAF Block 40)	283-284	L1-12 only	46-47 (N)	(16)
54. Manufacturer of Failed Material (3rd Line Item on MAF Block 40)	285-289	L1-12 only	55-59 (AN)	(16)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
55. Part No./Ref. Symbol of Failed Material (3rd Line Item on MAF Block 40)	290-304	L1-12 only	60-74 (AN)	(16)
56. ARINC Research Failed Material Code (3rd Line Item on MAF Block 40)	305-308	None	None	(17)
57. Action Taken on Failed Material (4th Line Item on MAF Block 40)	309	L1-12 only	42 (A)	(16)
58. Malfunction Code on Failed Material (4th Line Item on MAF Block 40)	310-312	L1-12 only	43-45 (AN)	(16)
59. Quantity of Failed Material (4th Line Item on MAF Block 40)	313-314	L1-12 only	46-47 (N)	(16)
60. Manufacturer of Failed Material (4th Line Item on MAF Block 40)	315-319	L1-12 only	55-59 (AN)	(16)
61. Part No./Ref. Symbol of Failed Material (4th Line Item on MAF Block 40)	320-334	L1-12 only	60-74 (AN)	(16)
62. ARINC Research Failed Material Code (4th Line Item on MAF Block 40)	335-338	None	None	(17)
63. Action Taken on Failed Material (5th Line Item on MAF Block 40)	339	L1-12 only	42 (A)	(16)
64. Malfunction Code on Failed Material (5th Line Item on MAF Block 40)	340-342	L1-12 only	43-45 (AN)	(16)
65. Quantity of Failed Material (5th Line Item on MAF Block 40)	343-344	L1-12 only	46-47 (N)	(16)
66. Manufacturer of Failed Material (5th Line Item on MAF Block 40)	345-349	L1-12 only	55-59 (AN)	(16)
67. Part No./Ref. Symbol of Failed Material (5th Line Item on MAF Block 40)	350-364	L1-12 only	60-74 (AN)	(16)
68. ARINC Research Failed Material Code (5th Line Item on MAF Block 40)	365-368	None	None	(17)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
69. Action Taken on Failed Material (6th Line Item on MAF Block 40)	369	L1-12 only	42 (A)	(16)
70. Malfunction Code on Failed Material (6th Line Item on MAF Block 40)	370-372	L1-12 only	43-45 (AN)	(16)
71. Quantity of Failed Material (6th Line Item on MAF Block 40)	373-374	L1-12 only	46-47 (N)	(16)
72. Manufacturer of Failed Material (6th Line Item on MAF Block 40)	375-379	L1-12 only	55-59 (AN)	(16)
73. Part No./Ref. Symbol of Failed Material (6th Line Item on MAF Block 40)	380-394	L1-12 only	60-74 (AN)	(16)
74. ARINC Research Failed Material Code (6th Line Item on MAF Block 40)	395-398	None	None	(17)
III. INTERMEDIATE MAINTENANCE DATA (LEVEL 2) - ACTIONS ON LRU's OR SYSTEM PARTS				
Maintenance Action Description				
75. Action Organization, L2	399-401	L2-11,12,31,32,41,46,47	22-24 (AN)	(18)
76. Work Center, L2	402-404	21,22; L2-41,46,47	25-27 (AN)	(18F)
77. Action Date, L2	405-408	31,32; L2-41,46,47	29-32 (N)	(18A)
78. Action Taken, L2	409	31 only	42 (AN)	(18E)
79. Malfunction Code, L2	410-412	31 only	43-45 (N)	(18C)
80. Items Processed, L2	413-414	31, L2-41	46-47 (N)	(18D)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
81. Man-Hours, L2	415-418	31, L2-41	48-51 (N)	(15B)
82. Elapsed Maintenance Time, L2	419-421	31, L2-41	52-54 (N)	(15B)
Repair Cycle Data (Level 2 - LR or System Part Repairs				
83. Date Removed from System	422-425	34 only	27-30 (N)	(19)
84. Date Received at Material Control	426-429	34 only	31-34 (N)	(19)
85. Date Work Started	430-433	34 only	35-38 (N)	(19)
86. Date Work Completed	434-437	34 only	39-42 (N)	(19)
87. Date to AWP (First)	438-441	34 only	43-46 (N)	(19)
88. Date off AWP (First)	442-445	34 only	47-50 (N)	(19)
89. Date to AWP (Second)	446-449	34 only	51-54 (N)	(19)
90. Date off AWP (Second)	450-453	34 only	55-58 (N)	(19)
91. ARINC Research Repair Cycle Notes	454-457	None	None	(20)
Failed Material from Level 2 Repairs of LRU or System Parts				
92. Action Taken on Failed Material (1st Line Item on MAF-MC3 Block 40)	458	32 only	42 (AN)	(16C)
93. Malfunction Code (1st Line Item on MAF-MC3 Block 40)	459-461	L2-12,32	43-45 (N)	(16A)
94. Quantity of Failed Material (1st Line Item on MAF-MC3 Block 40)	462-463	32 only	46-47 (N)	(16C)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
95. MFG. of Failed Material (1st Line Item on MAF-MC3 Block 40)	464-468	L2-12, 32	55-59 (AN)	(16A)
96. Part Number of Failed Material (1st Line Item on MAF-MC3 Block 40)	469-483	L2-12, 32	60-74	(16A)
97. ARINC Research Failed Material Notes (1st Line Item on MAF-MC3 Block 40)	484-487	None	None	(17A)
98. Action Taken on Failed Material (2nd Line Item on MAF-MC3 Block 40)	488	32 only	42 (AN)	(16C)
99. Malfunction Code (2nd Line Item on MAF-MC3 Block 40)	489-491	L2-12, 32	43-45 (N)	(16A)
100. Quantity of Failed Material (2nd Line Item on MAF-MC3 Block 40)	492-493	32 only	46-47 (N)	(16C)
101. MFG. of Failed Material (2nd Line Item on MAF-MC3 Block 40)	494-498	L2-12, 32	55-59 (AN)	(16A)
102. Part No. of Failed Material (2nd Line Item on MAF-MC3 Block 40)	499-513	L2-12, 32	60-74 (AN)	(16A)
103. ARINC Research Failed Material Note (2nd Line Item on MAF-MC3 Block 40)	514-517	None	None	(17A)
104. Action Taken on Failed Material (3rd Line Item on MAF-MC3 Block 40)	518	32 only	42 (AN)	(16C)
105. Malfunction Code (3rd Line Item on MAF-MC3 Block 40)	519-521	L2-12, 32	43-45 (N)	(16A)
106. Quantity of Failed Material (3rd Line Item on MAF-MC3 Block 40)	522-523	32 only	46-47 (N)	(16C)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
107. MFG. of Failed Material (3rd Line Item on MAF-MC3 Block 40)	524-528	L2-12, 32	55-59 (AN)	(16A)
108. Part No. of Failed Material (3rd Line Item on MAF-MC3 Block 40)	529-543	L2-12, 32	60-74 (AN)	(16A)
109. ARINC Research Failed Material Note (3rd Line Item on MAF-MC3 Block 40)	544-547	None	None	(17A)
110. Action Taken on Failed Material (4th Line Item on MAF-MC3 Block 40)	548	32 only	42 (AN)	(16C)
111. Malfunction Code (4th Line Item on MAF-MC3 Block 40)	549-551	L2-12, 32	43-45 (N)	(16A)
112. Quantity of Failed Material (4th Line Item on MAF-MC3 Block 40)	552-553	32 only	46-47 (N)	(16C)
113. MFG. of Failed Material (4th Line Item on MAF-MC3 Block 40)	554-558	L2-12, 32	55-59 (AN)	(16A)
114. Part No. of Failed Material (4th Line Item on MAF-MC3 Block 40)	559-573	L2-12, 32	60-74 (AN)	(16A)
115. ARINC Research Failed Material Note (4th Line Item on MAF-MC3 Block 40)	574-577	None	None	(17A)
116. Action Taken on Failed Material (5th Line Item on MAF-MC3 Block 40)	578	32 only	42 (AN)	(16C)
117. Malfunction Code (5th Line Item on MAF-MC3 Block 40)	579-581	L2-12, 32	43-45 (N)	(16A)
118. Quantity of Failed Material (5th Line Item on MAF-MC3 Block 40)	582-583	32 only	46-47 (N)	(16C)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
119. MFG. of Failed Material (5th Line Item on MAF-MC3 Block 40)	584-588	L2-12, 32	55-59 (AN)	(16A)
120. Part No. of Failed Material (5th Line Item on MAF-MC3 Block 40)	589-603	L2-12, 32	60-74 (AN)	(16A)
121. ARINC Research Failed Material Note (5th Line Item on MAF-MC3 Block 40)	604-607	None	None	(17A)
122. Action Taken on Failed Material (6th Line Item on MAF-MC3 Block 40)	608	32 only	42 (AN)	(16C)
123. Malfunction Code (6th Line Item on MAF-MC3 Block 40)	609-611	L2-12, 32	43-45 (N)	(16A)
124. Quantity of Failed Material (6th Line Item on MAF-MC3 Block 40)	612-613	32 only	46-47 (N)	(16C)
125. MFG. of Failed Material (6th Line Item on MAF-MC3 Block 40)	614-618	L2-12, 32	55-59 (AN)	(16A)
126. Part No. of Failed Material (6th Line Item on MAF-MC3 Block 40)	619-633	L2-12, 32	60-74 (AN)	(16A)
127. ARINC Research Failed Material Note (6th Line Item on MAF-MC3 Block 40)	634-637	None	None	(17A)
IV. INTERMEDIATE MAINTENANCE DATA (LEVEL 2) - SUBASSEMBLY OR LRU PART ACTIONS				
Maintenance Action Description				
128. Action Organization for Subassembly Repair	638-640	L2-11,12,31,32	22-24 (AN)	(22)
129. Work Center for Subassembly Repair	641-643	31,32	25-27 (AN)	(22E)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
130. Action Date for Subassembly	644-647	31,32	29-32 (AN)	(22B)
131. Work Unit Code for Subassembly	648-654	L2-11,12,31,32	33-39 (AN)	(22)
132. When Discovered Code for Subassembly	655	L2-11,12,31,32	40 (AN)	(22)
133. Type Maintenance for Subassembly	656	L2-11,12,31,32	41 (A)	(22)
134. Action Taken on Subassembly	657	31 only	42 (AN)	(22C)
135. Malfunction Description for Subassembly	658-660	31 only	43-45 (AN)	(22D)
136. Items Processed, Subassembly	661-662	31 only	46-47 (N)	(22C)
137. Man-Hours on Subassembly Repair	663-666	31 only	48-51 (N)	(22A)
138. EMT for Subassembly Repair	667-669	31 only	52-54 (N)	(22A)
139. Manufacturer of Subassembly	670-674	31 only	55-59 (AN)	(22C)
140. Part Number of Subassembly	675-689	31 only	60-74 (AN)	(22C)
141. Serial Number of Subassembly	690-699	34 only	12-21 (AN)	(23)
142. Time/Cycles for Subassembly	700-704	34 only	22-26 (AN)	(23)
143. Reference Designator for Subassembly	705-716	None	None	(15E)
Repair Cycle Data - Level 2 Subassembly or LRU Part Repairs				
144. Date of Removal of Subassembly from LRU	717-720	34 only	27-30 (N)	(23)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
145. Date of Receipt of Subassembly At Material Control Station	721-724	34 only	31-34 (N)	(23)
146. Date Subassembly Work Started	725-728	34 only	35-38 (N)	(23)
147. Date Subassembly Work Completed	729-732	34 only	39-42 (N)	(23)
148. Date to AWP (First)	733-736	34 only	43-46 (N)	(23)
149. Date off AWP (First)	737-740	34 only	47-50 (N)	(23)
150. Date to AWP (Second)	741-744	34 only	51-54 (N)	(23)
151. Date off AWP (Second)	745-748	34 only	55-58 (N)	(23)
152. Date to AWP (Third)	749-752	34 only	59-62 (N)	(23)
153. Date off AWP (Third)	753-756	34 only	63-66	(23)
Failed Material (Level 2) - Piece Parts from Subassemblies or LRU Parts				
154. Action Taken on Material (1st Line Item on Suffixed MAF-MC3 Block 40)	757	32 only	42 (AN)	(16D)
155. Malfunction Code (1st Line Item on Suffixed MAF-MC3 Block 40)	758-760	L2-12, 32	43-45 (AN)	(16E)
156. Quantity of Failed Material (1st Line Item on Suffixed MAF-MC3 Block 40)	761-762	32 only	46-47 (N)	(16D)
157. MFG. Of Failed Material (1st Line Item on Suffixed MAF-MC3 Block 40)	763-767	L2-12, 32	48-52 (AN)	(16E)
158. Part No. of Failed Material (1st Line Item on Suffixed MAF-MC3 Block 40)	768-782	L2-12, 32	60-74 (AN)	(16F)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
159. ARINC Research Failed Material Note (1st Line Item on Suffixed MAF-MC3 Block 40)	783-788	None	None	(17B)
160. Action Taken on Failed Material (2nd Line Item on Suffixed MAF-MC3 Block 40)	789	32 only	42 (AN)	(16D)
161. Malfunction Code (2nd Line Item on Suffixed MAF-MC3 Block 40)	790-792	L2-12, 32	43-45 (AN)	(16B)
162. Quantity of Failed Material (2nd Line Item on Suffixed MAF-MC3 Block 40)	793-794	32 only	46-47 (N)	(16D)
163. MFG. of Failed Material (2nd Line Item on Suffixed MAF-MC3 Block 40)	795-799	L2-12, 32	55-59 (AN)	(16B)
164. Part No. of Failed Material (2nd Line Item on Suffixed MAF-MC3 Block 40)	800-814	L2-12, 32	60-74 (AN)	(16B)
165. ARINC Research Failed Material Note (2nd Line Item on Suffixed MAF-MC3 Block 40)	815-820	None	None	(17B)
166. Action Taken on Material (3rd Line Item on Suffixed MAF-MC3 Block 40)	821	32 only	42 (AN)	(16D)
167. Malfunction Code (3rd Line Item on Suffixed MAF-MC3 Block 40)	822-824	L2-12, 32	43-45 (AN)	(16B)
168. Quantity of Failed Material (3rd Line Item on Suffixed MAF-MC3 Block 40)	825-826	32 only	46-47 (N)	(16D)

ARINC RESEARCH
MDCS-980 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
169. MFG. of Failed Material (3rd Line Item on Suffixed MAF-MC3 Block 40)	827-831	L2-12, 32	55-59 (AN)	(16B)
170. Part No. of Failed Material (3rd Line Item on Suffixed MAF-MC3 Block 40)	832-846	L2-12, 32	60-74 (AN)	(16B)
171. ARINC Research Failed Material Note (3rd Line Item on Suffixed MAF-MC3 Block 40)	847-852	None	None	(17B)
172. Action Taken on Failed Material (4th Line Item on Suffixed MAF-MC3 Block 40)	853	32 only	42 (AN)	(16D)
173. Malfunction Code (4th Line Item on Suffixed MAF-MC3 Block 40)	854-856	L2-12, 32	43-45 (AN)	(16B)
174. Quantity of Failed Material (4th Line Item on Suffixed MAF-MC3 Block 40)	857-858	32 only	46-47 (N)	(16D)
175. MFG. of Failed Material (4th Line Item on Suffixed MAF-MC3 Block 40)	859-863	L2-12, 32	55-59 (AN)	(16B)
176. Part No. of Failed Material (4th Line Item on Suffixed MAF-MC3 Block 40)	864-878	L2-12, 32	60-74 (AN)	(16B)
177. ARINC Research Failed Material Note (4th Line Item on Suffixed MAF-MC3 Block 40)	879-884	None	None	(17B)
178. Action Taken on Material (5th Line Item on Suffixed MAF-MC3 Block 40)	885	32 only	42 (AN)	(16D)
179. Malfunction Code (5th Line Item on Suffixed MAF-MC3 Block 40)	886-888	L2-12, 32	43-45 (AN)	(16B)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
180. Quantity of Failed Material (5th Line Item on Suffixed MAF-MC3 Block 40)	889-890	32 only	46-57 (AN)	(16D)
181. MFG. of Failed Material (5th Line Item on Suffixed MAF-MC3 Block 40)	891-895	L2-12,32	55-59 (AN)	(16B)
182. Part No. of Failed Material (5th Line Item on Suffixed MAF-MC3 Block 40)	896-910	L2-12,32	60-74 (AN)	(16B)
183. ARINC Research Failed Material Note (5th Line Item on Suffixed MAF-MC3 Block 40)	911-916	None	None	(17B)
184. Action Taken on Failed Material (6th Line Item on Suffixed MAF-MC3 Block 40)	917	32 only	42 (AN)	(16D)
185. Malfunction Code (6th Line Item on Suffixed MAF-MC3 Block 40)	918-920	L2-12,32	43-45 (AN)	(16B)
186. Quantity of Failed Material (6th Line Item on Suffixed MAF-MC3 Block 40)	921-922	32 only	46-47 (AN)	(16D)
187. MFG. of Failed Material (6th Line Item of Suffixed MAF-MC3 Block 40)	923-927	L2-12,32	55-59 (AN)	(16B)
188. Part No. of Failed Material (6th Line Item on Suffixed MAF-MC3 Block 40)	928-942	L2-12, 32	60-74 (AN)	(16B)
189. ARINC Research Failed Material Note (6th Line Item on Suffixed MAF-MC3 Block 40)	943-948	None	None	(17B)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
V. LEVEL 1 - PRIMARY WORK CENTER AND LEVEL 2 - WORK CENTER MAN-HOURS ACCOUNTING (WHILE WORK CONTINUES) AND WORK STOPPAGE MAN-HOURS ACCOUNTING DATA				
190.(First, Level 1) Man-Hours Accounting Action Date to Close Accounting Period	949-952	L1-11 only	29-32 (N)	(26)
191.(First, Level 1) Man-Hours at Accounting Closeout Date	953-956	L1-11 only	48-51 (N)	(26B)
192.(First, Level 1) EMT at Accounting Closeout Date	957-959	L1-11 only	52-54 (N)	(26B)
193.(Second, Level 1) Man-Hours Accounting Action Date to Close Accounting Period	960-963	L1-11 only	29-32 (N)	(26A)
194.(Second, Level 1) Man-Hours at Accounting Closeout Date	964-967	L1-11 only	48-51 (N)	(26C)
195.(Second, Level 1) EMT at Accounting Closeout Date	968-970	L1-11 only	52-54 (N)	(26C)
196.(First, Level 1) Work Stoppage Code	971	L1-11 only	42 (AN)	(27)
197.(First, Level 1) Work Stoppage Action Date	972-975	L1-11 only	29-32 (N)	(27F)
198.(First, Level 1) Man-Hours at Work Stoppage Date	976-979	L1-11 only	48-51 (N)	(27F)
199.(First, Level 1) EMT at Work Stoppage Date	980-982	L1-11 only	52-54 (N)	(27F)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
200. (Second, Level 1) Work Stoppage Code	983	L1-11 only	42 (AN)	(27A)
201. (Second, Level 1) Work Stoppage Action Date	984-987	L1-11 only	29-32 (N)	(27G)
202. (Second, Level 1) Man-Hours at Work Stoppage Date	988-991	L1-11 only	48-51 (N)	(27G)
203. (Second, Level 1) EMT at Work Stoppage Date	992-994	L1-11 only	52-54 (N)	(27G)
204. (Third, Level 1) Work Stoppage Code	995	L1-11 only	42 (AN)	(27B)
205. (Third, Level 1) Work Stoppage Action Date	996-999	L1-11 only	29-32 (N)	(27H)
206. (Third, Level 1) Man-Hours at Work Stoppage Date	1000-1003	L1-11 only	48-51 (N)	(27H)
207. (Third, Level 1) EMT at Work Stoppage Date	1004-1006	L1-11 only	52-54 (N)	(27H)
208. (Fourth, Level 1) Work Stoppage Code	1007	L1-11 only	42 (AN)	(27C)
209. (Fourth, Level 1) Work Stoppage Action Date	1008-1011	L1-11 only	29-32 (N)	(27I)
210. (Fourth, Level 1) Man-Hours at Work Stoppage Date	1012-1015	L1-11 only	48-51 (N)	(27I)
211. (Fourth, Level 1) EMT at Work Stoppage Date	1016-1018	L1-11 only	52-54 (N)	(27I)
212. (Fifth, Level 1) Work Stoppage Code	1019	L1-11 only	42 (AN)	(27D)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
213. (Fifth, Level 1) Work Stoppage Action Date	1020-1023	L1-11 only	29-32 (N)	(27J)
214. (Fifth, Level 1) Man-Hours at Work Stoppage Date	1024-1027	L1-11 only	48-51 (N)	(27J)
215. (Fifth, Level 1) EMT at Work Stoppage Date	1028-1030	L1-11 only	52-54 (N)	(27J)
216. (Sixth, Level 1) Work Stoppage Code	1031	L1-11 only	42 (AN)	(27E)
217. (Sixth, Level 1) Work Stoppage Action Date	1032-1035	L1-11 only	29-32 (N)	(27K)
218. (Sixth, Level 1) Man-Hours at Work Stoppage Date	1036-1039	L1-11 only	48-51 (N)	(27K)
219. (Sixth, Level 1) EMT at Work Stoppage Date	1040-1042	L1-11 only	52-54 (N)	(27K)
220. (First, Level 2) Man-Hours Accounting Action Date to Closeout Accounting Period	1043-1046	L2-11 only	29-32 (N)	(29)
221. (First, Level 2) Man-Hours at Accounting Period Closeout Date	1047-1050	L2-11 only	48-51 (N)	(29B)
222. (First, Level 2) EMT at Accounting Period Closeout Date	1051-1053	L2-11 only	52-54 (N)	(29B)
223. (Second, Level 2) Man-Hours Accounting Action Date to Closeout Accounting Period	1054-1057	L2-11 only	29-32 (N)	(29A)
224. (Second, Level 2) Man-Hours at Accounting Period Closeout Date	1058-1061	L2-11 only	48-51 (N)	(29C)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
225. (Second, Level 2) EMT Accounting Period Closeout Date	1062-1064	L2-11 only	52-54 (N)	(29C)
226. (First, Level 2) Work Stoppage Code	1065	L2-11, 31	42 (AN)	(30)
227. (First, Level 2) Work Stoppage Action Date	1066-1069	L2-11, 12, 31	29-32 (N)	(31)
228. (First, Level 2) Man-Hours at Work Stoppage Date	1070-1073	L2-11, 31	48-51 (N)	(30D)
229. (First, Level 2) EMT at Work Stoppage Date	1074-1076	L2-11, 31	52-54 (N)	(30D)
230. (Second, Level 2) Work Stoppage Code	1077	L2-11, 31	42 (AN)	(30A)
231. (Second, Level 2) Work Stoppage Action Date	1078-1081	L2-11, 12, 31	29-32 (N)	(31A)
232. (Second, Level 2) Man-Hours at Work Stoppage Date	1082-1085	L2-11, 31	48-51 (N)	(30E)
233. (Second, Level 2) EMT at Work Stoppage Date	1086-1088	L2-11, 31	52-54 (N)	(30E)
234. (Third, Level 2) Work Stoppage Code	1089	L2-11, 31	42 (AN)	(30B)
235. (Third, Level 2) Work Stoppage Action Date	1090-1093	L2-11, 12, 31	29-32 (N)	(31B)
236. (Third, Level 2) Man-Hours at Work Stoppage Date	1094-1097	L2-11, 31	48-51 (N)	(30F)
237. (Third, Level 2) EMT at Work Stoppage Date	1098-1100	L2-11, 31	52-54 (N)	(30F)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
238. (Fourth, Level 2) Work Stoppage Code	1101	L2-11, 31	42 (AN)	(30C)
239. (Fourth, Level 2) Work Stoppage Action Date	1102-1105	L2-11, 12, 31	29-32 (N)	(31C)
240. (Fourth, Level 2) Man-Hours at Work Stoppage Date	1106-1109	L2-11, 31	48-51 (N)	(30G)
241. (Fourth, Level 2) EMT at Work Stoppage Date	1110-1112	L2-11, 31	52-54 (N)	(30G)
VI. TROUBLESHOOTING (T.S.) TIME DATA - MAINTENANCE LEVEL 1				
242. T.S. Malfunction Code	1113-1115	L1-11 only	43-45 (N)	(32)
243. T.S. Action Date	1116-1119	L1-11 only	29-32 (N)	(32A)
244. T.S. Man-Hours	1120-1123	L1-11 only	48-51 (N)	(32A)
245. T.S. EMT (Hours)	1124-1126	L1-11 only	52-54 (N)	(32A)
VII. TROUBLESHOOTING (T.S.) TIME DATA - MAINTENANCE LEVEL 2				
246. T.S. Malfunction Code	1127-1129	L2-11 only	43-45 (N)	(32B)
247. T.S. Action Date	1130-1133	L2-11 only	29-32 (N)	(32C)
248. T.S. Man-Hours	1134-1137	L2-11 only	48-51 (N)	(32C)
249. T.S. EMT (Hours)	1138-1140	L2-11 only	52-54 (N)	(32C)
VIII. ASSISTING WORK CENTER ACTIONS				
250. Action Organization (First Assisting WC)	1141-1143	L1 or L2-11	22-24 (AN)	(33)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
251. Assisting Work Center Code (First Assisting WC)	1144-1146	L1 or L2-11	25-27 (AN)	(33B)
252. Assisting Work Center Maintenance Level (First Assisting Center)	1147	L1 or L2-11	28 (N)	(33B)
253. First Assisting Work Center Action Taken Code	1148	L1 or L2-11	42 (AN)	(33B)
254. First Assisting Work Center Action Date	1149-1152	L1 or L2-11	29-32 (N)	(33B)
255. First Assisting Work Center Man-Hours	1153-1156	L1 or L2-11	48-51 (N)	(33B)
256. First Assisting Work Center EMT (Hours)	1157-1159	L1 or L2-11	52-54 (N)	(33B)
257. Action Organization (Second Assisting WC)	1160-1162	L1 or L2-11	22-24 (AN)	(33A)
258. Assisting Work Center Code (Second Assisting WC)	1163-1165	L1 or L2-11	25-27 (AN)	(33C)
259. Assisting Work Center Maintenance Level (Second Assisting Center)	1166	L1 or L2-11	28 (N)	(33C)
260. Second Assisting Work Center Action Taken Code	1167	L1 or L2-11	42 (AN)	(33C)
261. Second Assisting Work Center Action Date	1168-1171	L1 or L2-11	29-32 (N)	(33C)
262. Second Assisting Work Center Man-Hours	1172-1175	L1 or L2-11	48-51 (N)	(33C)
263. Second Assisting Work Center EMT (Hours)	1176-1178	L1 or L2-11	52-54 (N)	(33C)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
IX. ASSISTING WORK CENTERS - MAN-HOUR ACCOUNTING (WHILE WORK CONTINUES) AND WORK STOPPAGE MAN-HOUR ACCOUNTING DATA				
264. Man-Hour Accounting Action Date (First Assisting WC) to Close Accounting Period	1179-1182	L1 or L2-11	29-32 (N)	(34)
265. Man-Hours at Account Period Closeout (First Assisting WC)	1183-1186	L1 or L2-11	48-51 (N)	(34B)
266. EMT at Account Period Closeout (First Assisting WC)	1187-1189	L1 or L2-11	52-54 (N)	(34B)
267. Man-Hour Accounting Action Date (Second Assisting WC) to Close Accounting Period	1190-1193	L1 or L2-11	29-32 (N)	(34A)
268. Man-Hours at Account Period Closeout (Second Assisting WC)	1194-1197	L1 or L2-11	48-51 (N)	(34C)
269. EMT at Account Period Closeout (Second Assisting WC)	1198-1200	L1 or L2-11	52-54 (N)	(34C)
270. Work Stoppage Action Taken Code (First Assisting WC)	1201	L1 or L2-11	42 (AN)	(35)
271. Work Stoppage Action Date (First Assisting WC)	1202-1205	L1 or L2-11	29-32 (N)	(35B)
272. Man-Hours at Work Stoppage (First Assisting WC)	1206-1209	L1 or L2-11	48-51 (N)	(35B)
273. EMT at Work Stoppage Date (First Assisting WC)	1210-1212	L1 or L2-11	52-54 (N)	(35B)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
274. Work Stoppage Action Taken Code (Second Assisting WC)	1213	L1 or L2-11	42 (AN)	(35A)
275. Work Stoppage Action Date (Second Assisting WC)	1214-1217	L1 or L2-11	29-32 (N)	(35C)
276. Man-Hours at Work Stoppage Date (Second Assisting WC)	1218-1221	L1 or L2-11	48-51 (N)	(35C)
277. EMT at Work Stoppage Date (Second Assisting WC)	1222-1224	L1 or L2-11	52-54 (N)	(35C)
X. DATA ON LEVEL-2 MAN-HOUR ACCOUNTING (WHILE WORK CONTINUES) AND WORK STOPPAGE DURING SUBASSEMBLY REPAIR				
278. Subassembly Repair Work Center's Man-Hour Accounting Action Date to Close Accounting Period	1225-1228	L2-11 only	29-32 (N)	(36)
279. Man-Hours for Subassembly Repair WC to Close Accounting Period	1229-1232	L2-11 only	48-51 (N)	(36A)
280. EMT for Subassembly Repair WC to Close Accounting Period	1233-1235	L2-11 only	52-54 (N)	(36A)
281. Subassembly Repair - Work Stoppage Action Taken Code	1236	L2-11, 31	42 (AN)	(37)
282. Work Stoppage on Subassembly Repair Action Date	1237-1240	L2-11,12,31	29-32 (N)	(37A)
283. Man-Hours at Subassembly Repair Work Stoppage Action Date	1241-1244	L2-11, 31	48-51 (N)	(37B)
284. EMT at Subassembly Repair Work Stoppage Action Date	1245-1247	L2-11, 31	52-54 (N)	(37B)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
XI. TECHNICAL DIRECTIVE COMPLIANCE (TDC) DATA				
285. TDC Maintenance Level	1248	L1 or L2, 41, 46, 47	28	(39)
286. System on Which TDC Is Reported	1249-1250	L1 or L2, 41, 46, 47	33-34 (N)	(39)
287. TDC Status	1251	L1 or L2, 41, 46, 47	42 (A)	(39)
288. Interim Directive Indicator	1252	L1 or L2, 41 only	55 (A)	(39B)
TDC NUMBER				
289. Code	1253-1254	L1 or L2-41 only	56-57 (N)	(39B)
290. Basic Number	1255-1258	L1 or L2-41 only	58-61 (N)	(39B)
291. Revision	1259	L1 or L2-41 only	62 (N)	(39B)
292. Amendment	1260	L1 or L2-41 only	63 (N)	(39B)
293. Part	1261-1262	L1 or L2-41 only	64-65 (N)	(39B)
294. Kit	1263-1264	L1 or L2-41 only	66-67 (N)	(39B)
295. TDC Data Processing Correction Code (First Character)	1265	L1 or L2-41, 46	75 (N)	(39A)
TDC "OLD ITEM"				
296. Old Item Mfgr. Code	1266-1270	L1 or L2 - 46 only	45-49 (AN)	(40)
297. Old Item Serial Number	1271-1280	L1 or L2 - 46 only	50-59 (AN)	(40)
298. Old Item Part Number	1281-1295	L1 or L2 - 46 only	60-74 (AN)	(40)

ARINC RESEARCH
MDCS-983 DATA FILE FORMAT

Data Elements	ARINC Research Record Position	Selectable 3M-MDCS Card Types (See Notes)	3M C.T. COL.	Notes
TDC "NEW ITEM"				
299. New Item Mfgr. Code	1296-1300	L1 or L2 - 47 only	45-49 (AN)	(41)
300. New Item Serial Number	1301-1310	L1 or L2 - 47 only	50-59 (AN)	(41)
301. New Item Part Number	1311-1325	L1 or L2 - 47 only	60-74 (AN)	(41)
XII. DATA IN RESIDUE FILE				
302. Record Overflow Indicator	1326-1329	None	None	(38)

APPENDIX II
UH-1N ELEMENT-NUMBER DEFINITION

The listing presented on the following pages defines the 241 elements that constituted the UH-1N helicopter, in terms of data input to the operation and maintenance simulation model. Definition is by nomenclature, or nomenclature groupings in case of collective elements. Nomenclature is as presented in NAVAIR 01-110HC-8 (U.S. Navy Series H-1 Aircraft Work Unit Code Manual), which describes the Navy/Marine UH-1N utility helicopter (the aircraft selected by the Army and ARINC Research to establish a utility-helicopter data baseline).

The components and equipments defined by the nomenclature are not intended to represent an exhaustive listing of all parts of the helicopter. However, the listing does represent a complete helicopter breakdown on the basis of applicability of maintenance activity for the period of UH-1N data used in the program (January 1971 to May 1972).

The number of unscheduled maintenance actions associated with each element during the 11,804 flying hours in the data period is also tabulated in the listing. The tabulation is based on When Discovered Code (WDC) counts from the element maintenance-action (MA) records (since the probability of discovering a requirement for maintenance must be assigned to events in the simulation model). Because of the inclusion of partial records in the MA records file, work-center, elapsed-maintenance-time, and man-hour information can be present in the file without WDC identification. In the data used, there were four elements (0403, 0706, 0711, and 0809) without WDC information (these elements were, therefore, determined to exhibit a 0.999 probability of successfully completing each event in the simulation). The four elements were separately designated since one (0909-Air Management System, General) represented a complete system within the Power Plant Installation Group, two (0403-Collective Support Assembly and 0706-Mast Bearing) were significant mechanical time-change items, and one (0711-Main Transmission Oil Pump) represented another significant mechanical component. Elements 0403 and 0809 did have partial records of on-equipment repair; elements 0706 and 0711 had no records of maintenance.

There were 18 Time-Change Items (TCI) among the 241 elements. These are identified by a TCI notation in the listing. The overhaul interval (OI) or retirement interval (RI), in element/component operating hours, is also indicated for each TCI.

Element Numeric Designation*	Nomenclature/Definition
0101 (23)**	Nose Door
0102 (12)	Nose Lower Window
0103 (57)	Forward Fuselage, Other
	Forward Fuselage
	Nose Door Latch Mechanism
	Nose Door Seal
	Hinge Bracket
	Nose Door Hinge
	Nose Door Stay
	Skin
	Not Otherwise Coded (NOC)
0104 (18)	Windshield Assembly
0105 (40)	Upper Fuselage, Other
	Upper Fuselage
	Windshield Center Post
	Cabin Roof Window
	Upper Structure Frame
	Rescue Hoist Handle
	Canopy
	Skin
	NOC
0106 (48)	Crew Door
0107 (14)	Crew Door Latch Mechanism
0108 (12)	Crew Door Hinge
0109 (42)	Cargo Door
0110 (11)	Cargo Door Latch
0111 (30)	Equipment Compartment Door
0112 (68)	Center Fuselage, Other
	Center Fuselage
	Door Post
	Crew Door Striker Plate
	Cargo Door Roller
	Door Window Assembly
	Skin
	Wind/Rain Deflector
	NOC
0113 (56)	Lower Fuselage, General
	Lower Fuselage
	Bottom Structure Door
	Bottom Structure Door Hinge
	Bottom Structure Cover
	Panel Assembly
	Floor
	Seat Track

*First two digits represent system; second two digits represent element.
**Figures in parentheses represent number of unscheduled maintenance actions.

Cargo Tie-Down Fitting
Skin
Life Beam
NOC

0114 (34) Tail Boom Assembly
0115 (67) Aft Fuselage, Other
Aft Fuselage
Sync Elevator Support
Bulkhead
Tail Boom Fitting
Bearing Hanger Support Fitting
Tail Boom Door
Tail Boom Door Hinge
Aft Fuselage Fairing/Doubler
Gearbox Access Fin Cover
Skin
Tail Boom Retaining Bolt
NOC

0116 (78) Airframe, Other

0201 (13) Pilot/Copilot Seat
Armor Plate
0202 (14) Inertia Reel
0203 (30) Pilot's Compartment Furnishings, Other
Pilot's Compartment Furnishings
Safety Belt
Shoulder Harness
Instrument Panel
Overhead Console Panel
Cabin Soundproofing
Instrument Panel Glare Shield
NOC

0204 (11) Passenger Compartment Furnishings, General
Passenger Compartment Furnishings
Three-Man Seat
NOC

0205 (4) Fuselage Compartments, Other

0301 (45) Landing Skid
0302 (22) Cross Tube
0303 (17) Main Landing Gear Components, Other
Main Landing Gear Components
Saddle
Fwd/Aft Cap
Step
Landing Skid Shoe
Eyebolt

Nutplate
Wheel/Tire Assembly
Hand Pump
Ram Cylinder
Bleed Air Valve
Hydraulic Lines
Brake Assembly
Landing Skid Fairing
MLG Hard Points
NOC

0304 (14) Tail Skid Components, General
Tail Skid Components
Tail Boom Skid Tube
Retainer Block
NOC

0305 (5) Landing Gear, General

0401 (12) Collective Pitch/Power Control Stick
0402 (8) Collective Lever Assembly, TCI—3300 RI
0403 (0) Collective Support Assembly, TCI—3300 RI
0404 (3) Collective Pitch Magnetic Brake
0405 (44) Collective Pitch Controls, Other
Collective Pitch Controls
Push-Pull Tube
Bell Crank
Arm Assembly
Boot Assembly
Jack Shaft
Dual Actuator
NOC

0406 (8) Cyclic Control Stick
0407 (4) Cyclic Bell Crank
0408 (7) Matched Link Set
0409 (10) Cyclic Force Gradient Assembly
0410 (17) Cyclic Control Magnetic Brake
0411 (14) Cyclic Swashplate/Support Assembly, TCI—1100 OI
0412 (20) Elevator Assembly, TCI—3000 RI
0413 (6) Elevator Horn Assembly, TCI—3000 RI
0414 (6) Cyclic Dual Actuator
0415 (20) Cyclic Controls, Other
Cyclic Controls
Push-Pull Tube
Tube/Lever Assembly
Boot Assembly
Elevator Bearing Support
NOC

0416 (9)	Tail Rotor Pedal Assembly
0417 (7)	Tail Rotor Control Push-Pull Tube
0418 (41)	Tail Rotor Controls, Other
	Tail Rotor Controls
	Tube/Lever Assembly
	Adjustment Assembly
	Bell Crank
	Support Assembly
	Chain
	Link Assembly
	Directional Actuator
	NOC
0419 (18)	Flight Control Cylinder/Control Valve
0420 (7)	Flight Control Hydraulic Components, Other
	Flight Control Hydraulic Components
	Irreversible Valve
	Solenoid Valve
	NOC
0421 (7)	Transmission Driven Hydraulic Pump (No. 1)
0422 (11)	Flight Control Hydraulic System (No. 1), Other
	Flight Control Hydraulic System
	Integrated Valve/Filter
	Pressure Shutoff Valve
0423 (2)	Flight Control Hydraulic System (No. 2), General
	Transmission Driven Hydraulic Pump
	Integrated Valve/Filter
0424 (2)	Flight Control Electrical, General
	Flight Control Electrical
	NOC
0425 (12)	Flight Controls, Other
0501 (50)	Stabilizer Bar Assembly
0502 (35)	Main Rotor Pitch Link
0503 (15)	Main Rotor Control Tube
0504 (11†)	Main Rotor Blade Assembly, TCI—2500 RI
0505 (6)	Main Rotor Hub Assembly, TCI—1100 OI
0506 (29)	Main Rotor Damper Assembly
0507 (25)	Scissors/Sleeve Assembly, TCI—1100 OI
0508 (3)	Main Rotor Power Grip Assembly
0509 (2)	Main Rotor Strap Set, TCI—2200 RI
0510 (81)	Main Rotor/Blade Components, Other
	Main Rotor/Blade Components
	Drag Brace
	Counterweight Assembly
	NOC

†UH-1N MRB unscheduled MAs; replaced by UH-1H and alternate MRB MA estimates in the simulations.

0511 (6) Tail Rotor Hub Assembly, TCI—1100 RI
0512 (2) Tail Rotor Blade Assembly, TCI—1100 RI
0513 (6) Pitch Change Link
0514 (3) Tail Rotor Crosshead Assembly
0515 (6) Tail Rotor Counterweight Assembly
0516 (25) Tail Rotor/Blade Components, Other
Tail Rotor/Blade Components
NOC

0517 (12) Helicopter Rotor System, General

0601 (15) Compressor Section (T400 CP), General
Compressor Section
Inlet Case Assembly
NOC

0602 (11) Combustion Section (T400 CP), General
Combustion Section
Combustion Chamber Housing
Combustion Chamber Liner
Combustion Chamber Exit Duct (Large)
NOC

0603 (2) Turbine Section (T400 CP), General
NOC

0604 (10) Exhaust Section (T400 CP), General
Exhaust Section
Power Section Insulation Blanket
Exhaust Duct Assembly
NOC

0605 (27) Reduction Gearbox Assembly (T400 CP), General
Reduction Gearbox Assembly
Input Shaft
Output Shaft
0606 (19) Accessory Gearbox Assembly (T400 CP), General
Accessory Gearbox Assembly
Housing
Housing Cover
Centrifugal Breather Impeller
0607 (38) Reduction/Accessory Gearbox Assembly (T400 CO), Other
Reduction/Accessory Gearbox Assembly
NOC

0608 (33) Fuel Control Assembly (T400 CP), General
Fuel Control Assembly
Automatic Fuel Control Unit
Manual Fuel Control Unit
0609 (18) Power Turbine Governor
0610 (21) Torque Control Unit
0611 (25) Main Fuel System (T400 CP), Other
Main Fuel System

Fuel Pump/Strainer Assembly
Fuel Manifold Inlet Adapter Assembly
Fuel Nozzle
Fuel Manifold Transfer Tube
Fuel Flow Divider/Dump Valve
NOC

0612 (21) Engine Oil Filter
0613 (49) Lubrication System (T400 CP), Other
Lubrication System
Main Oil Pressure/Scavenge Pump
Oil Pressure Check/Relief Valve
Combining Gearbox Oil Filter
Oil Transfer Tube (External)
Oil Pressure Tubing
Oil Nozzles
Oil Transfer Tube (Internal)
NOC

0614 (42) T-5 Temperature Limiter
0615 (17) T-5 Temperature Limiter Harness
0616 (28) Electrical System (T400 CP), Other
Electrical System
T-5 Thermocouple Probe
T-5 Temperature Limiter Solenoid Valve
T-5 Thermocouple Harness
Magnetic Chip Detector
NOC

0617 (8) Ignition System (T400 CP), General
Ignition System
Ignition Exciter Unit
Spark Ignition

0618 (21) T400 CP Engine, Other, TCI—1800 OI

0701 (8) Main Drive Shaft Assembly
0702 (6) Engine/Transmission Drive Shaft Installation, Other
Engine/Transmission Drive Shaft Installation
Housing
Fin Assembly
NOC

0703 (18) Main Transmission Assembly, TCI—1500 OI
0704 (15) Transmission Oil Filter
0705 (6) Mast Assembly, TCI—1500 OI
0706 (0) Mast Bearing, TCI—1500 RI
0707 (1) Main Input Quill Assembly, TCI—1500 OI
0708 (20) Pylon Installation, Other
Pylon Installation
Manifold

Coupling
Pylon Mount
Fitting Support Assembly
Filler Cap
Tubing
Hose
Damper Assembly
Link Assembly
NOC

0709 (4) Main Transmission Gearbox Electrical Components, General
Temperature Bulb
Thermoswitch
Warning Light
Magnetic Chip Detector

0710 (5) Main Transmission Oil Cooler
0711 (0) Main Transmission Oil Pump
0712 (16) Transmission Oil System, Other
Transmission Oil System
Drain Valve
Sump
Oil Pressure Switch
NOC

0713 (6) Rotor Brake Cylinder
0714 (6) Rotor Brake Assembly
0715 (6) Rotor Brake Disk/Quill
0716 (12) Rotor Brake System, Other
Rotor Brake Components
Pressure Switch
NOC

0717 (8) Tail Drive Shaft Assembly
0718 (10) Clamp
0719 (13) Hanger Assembly
0720 (13) Intermediate Gearbox (42°), TCI—1500 OI
0721 (16) Tail Gearbox (90°), TCI—1100 OI
0722 (1) Tail Rotor Quill Assembly
0723 (3) Tail Rotor Tube Assembly
0724 (20) Tail Rotor Drive System, Other
Intermediate Gearbox Magnetic Chip Detector
Tail Gearbox Magnetic Chip Detector
NOC

0725 (4) Helicopter Drives/Transmissions, Other

0801 (4) Engine Mount Installation, General
Trunnion
Pillow Block Assembly
Tripod Assembly

Bipod Assembly
Leg Assembly Housing

0802 (38) Engine Enclosure/Air Induction, General
Engine Enclosure/Air Induction
Air Induction Baffle Assembly
Fire Shield
Heat Shield
Door Assembly
Hinge Support Tube
Air Induction Screen
Particle Separator
Center Firewall Plenum Chamber

0803 (28) Engine Cowling, General
Engine Cowling
Cowl Door
0804 (8) Oil Cooler Blower Shroud
0805 (26) Cowling Installation, Other
Cowling Installation
Frame
Air Scoop
Latching Mechanism
NOC

0806 (22) Engine Top Cowl Panels
0807 (7) Engine Lower Cowls
0808 (14) Transmission/Engine Cowlings, Other
Transmission/Engine Cowlings
Transmission Fairing
Air Inlet Fairings
Engine Upper Cowls
Oil Cooler Fairing
Twin Gearbox Side Cowlings
Gearbox Access Door
NOC

0809 (0) Air Management System, General
Ejector

0810 (4) Droop Compensator Cam Box (Power Plant Controls)
0811 (47) Linear Actuator (PP Controls Droop Compensator Cam Box)
0812 (66) Flight Idle Stop
0813 (22) Throttle/Power Lever Installation, Other
Throttle/Power Lever Installation
Throttle Lever
Dual Twist Grip
Rod
Torque Shaft
NOC

0814 (8)	RPM Warning System, General RPM Warning System Limit Detector/Box NOC
0815 (4)	Oil Cooler (Aircraft Lubrication System)
0816 (8)	Air Driven Oil Cooler Blower
0817 (6)	Shaft Driven Oil Cooler Blower
0818 (16)	Aircraft Lubrication Components, Other Aircraft Lubrication Components Oil Tank NOC
0819 (3)	Aircraft Bleed Air Installation, General Tubing NOC
0820 (1)	Aircraft Exhaust Components, General Aircraft Exhaust Components Tail Pipe
0821 (2)	Power Plant Installation, Other
0901 (6)	Environmental Control Unit, General Environmental Control Unit Vent Blower Rigid Tubing NOC
0902 (11)	Heat/Defog/Defrost Electrical Components, General Heat/Defog/Defrost Electrical Components Heater Control Panel Sensing Element Temperature Selection Switch NOC
0903 (13)	Heat and Vent Duct
0904 (3)	Heat/Defog/Defrost Distribution, Other Heat/Defog/Defrost Distribution Heating Air Bleed Valve Defogging Control Lever Nozzle Assembly NOC
0905 (1)	Rain Removal Components, General NOC
0906 (4)	Air Distribution Installation, General Air Distribution Installation Blower Assembly

0907 (1)	Air Distribution Electrical, General Aft Outlet Switch Cabin Heat Control Switch
0908 (1)	Heat/Air System, Other
1001 (23)	AC Generator/Alternator
1002 (14)	Inverter
1003 (24)	Alternating Current Components, Other Alternating Current Components Emergency Inverter Supervisory Panel Voltage Regulator AC/DC Power Control Panel Instrument Transformer Failure Relay Power Control Relay External Power Relay Inverter Bus Transfer Relay Generator Line Contactor NOC
1004 (36)	DC Starter/Generator
1005 (61)	Battery
1006 (97)	DC Voltage Regulator
1007 (30)	Reverse Current Relay
1008 (36)	DC External Power Relay
1009 (25)	Direct Current Components, Other Direct Current Components Overvoltage Relay Field Relay Split Bus Start Relay Common Bus Starter Relay Battery Relay External Power Receptacle NOC
1010 (11)	Aircraft Wiring, General Miscellaneous Aircraft Circuits Copilot's Collective Stick Wiring Pilot's Collective Stick Wiring Pedestal Wiring Copilot's Cyclic Stick Wiring Pilot's Cyclic Stick Wiring Overhead Console Panel Wiring NOC
1011 (3)	Engine Instrument Circuits, General Engine Instrument Circuits Temperature Instruments Wiring
1012 (1)	Flight Instrument Circuits, General

	Attitude Indicator System Wiring
1013 (5)	Lighting Circuits, General
	Lighting Circuits
	Interior Lighting Wiring
	Exterior Lighting Wiring
1014 (1)	DC Power Circuits, General
	DC Power System Wiring
1015 (3)	Fuel/Oil Circuits, General
	Engine Accessories System Wiring
1016 (5)	Radio Aircraft Circuits, General
	Nose Compartment Radio Wiring
	Comm Junction Box Wiring
	ICS System Wiring
1017 (14)	Warning/Emergency Circuits, General
	Warning/Emergency Circuits
	RPM Warning System Wiring
	Caution/Warning Lights Wiring
1018 (1)	AC Power Circuits, General
	NOC
1019 (14)	Electrical System, Other
1101 (10)	Master Caution Light
1102 (13)	Cockpit Light
1103 (6)	Master Caution Panel
1104 (24)	Instrument Light Control Panel
1105 (33)	Interior Lighting, Other
	Interior Lighting Equipment
	HI LO RPM Light
	Transmission Oil Level Light
	Edge Light Panel Light
	Dome Light
	Aft Dome Lights Control Panel
	Pitot Heat/Fwd Dome Lights Control Panel
	Chip Detector Fault Light
	Instrument Light
	NOC
1106 (18)	Searchlight
1107 (23)	Anticollision Light
1108 (19)	Position Light
1109 (32)	Exterior Lighting, Other
	Exterior Lighting Equipment
	Landing Light
	Tail Light
	Control Panel
	Flasher Unit
	Rotor Tip Formation Light
	NOC
1110 (2)	Lighting System, Other

1201 (7) Engine Driven Hydraulic Pump
1202 (8) Hydraulic Pressure Source, Other
- Hydraulic Pressure Source
- System Pressure Hose/Tubing
- System Return Hose/Tubing
- NOC

1203 (10) Hydraulic Fluid Supply, General
- Hydraulic Fluid Supply
- Reservoir
- NOC

1204 (2) Hydraulic Reservoir Pressurization, General
- Hydraulic Reservoir Pressurization
- Check Valve

1205 (13) Hydraulic Module Assembly
1206 (18) Hydraulic Filter
1207 (7) Hydraulic Control Valves, Other
- Hydraulic Control Valves
- System Relief Valve
- Solenoid Shutoff Valve
- Check Valve
- NOC

1208 (5) Hydraulic Pressure Indication
- Hydraulic Pressure Indication
- Pressure Switch

1209 (3) Hydraulic Power, Other

1301 (12) Sump/Boost Pump
1302 (12) Main Fuel Filter
1303 (25) Fuel Supply and Distribution, Other
- Fuel Supply and Distribution
- Fuel Cell
- Fuel Cap Assembly
- Strainer
- Shutoff Valve
- Check Valve
- Sump/Trap Drain Valve
- Float Switch
- Pressure Switch
- Flexible Hose
- NOC

1304 (4) Auxiliary Fuel Components, General
- Auxiliary Fuel Components
- Tank
- Control Panel

1305 (3)	Fuel System, Other
1401 (8)	Fire Warning/Detector Components, General Fire Warning/Detector Components Fire Detection Test Switch Fire Warning Light Fire Detection Element NOC
1402 (8)	Fire Extinguishing Components, General Fire Extinguishing Components Nitrogen Fire Bottle
1403 (3)	Windshield Wiper System, General Windshield Wiper System
1404 (11)	Windshield Wiper Mechanical Components, General Windshield Wiper Mechanical Components Converter Motor Blade Blade Arm Motor Cover Guard
1405 (6)	Rescue Hoist Assembly
1406 (5)	Rescue Hoist Mechanical Components, Other Rescue Hoist Mechanical Components Boom Actuator Arm Cable NOC
1407 (12)	Rescue Hoist Electrical Components, General Rescue Hoist Electrical Components Boom Actuator Up Limit Switch Hoist Sense Control Cable Cutter Switch Control Assembly
1408 (2)	Cargo Suspension Mechanical Components, General Cargo Suspension System Hook Release Pedal NOC
1409 (1)	Cargo Suspension Electrical Components, General NOC
1410 (2)	Aerial Dispensers, General Aerial Insecticide Dispenser
1411 (2)	Airborne Generator Illuminator Lighting (AGIL) System, General

DC Generator Regulator
System Control Unit Case

1501 (26) Airspeed Indicator
1502 (17) AAU7/A Pressure Altimeter
1503 (12) Turn/Slip Indicator
1504 (55) Attitude Indicator
1505 (14) Flight Indicators, Other
Flight Indicators
Vertical Speed Indicator
Rate-of-Climb Indicator
Directional Gyro
AAU21/A Altimeter Encoder

1506 (2) Pitot Static System, General
Pitot Static System

1507 (20) Miscellaneous Flight Instruments
Elapsed Time Clock
Outside Air Temperature Indicator
Dual AC/DC Voltmeter
DC Loadmeter

1508 (8) Navigation Instruments, General
Navigational Indicators
Magnetic/Standby Compass

1509 (11) Radio Magnetic Indicator (MA-1)
1510 (15) Compass Systems, Other
J-2 Compass System
Radio Magnetic Indicator (J-2)
Compass Transmitter (J-2)
MA-1 Compass System
Amplifier (MA-1)
Directional Gyro (MA-1)

1511 (20) Engine Tachometer Indication, General
Engine Tachometer Indication
Gas Producer Tachometer Generator
Gas Producer Tachometer Indicator
Triple Tachometer Indicator
NOC

1512 (9) Engine Turbine Inlet Temperature Indicator
1513 (13) Engine Temperature Indication, Other
Engine Temperature Indication
NOC

1514 (10) Engine Oil Pressure/Temperature Indicator
1515 (34) Torque Meter (Pressure Indication)
1516 (15) Engine Pressure Indication, Other

Engine Pressure Indication
Fuel Pressure Indicator
NOC

1517 (1) Engine Fuel Flow Indication, General
Engine Fuel Flow Transmitter

1518 (9) Transmission Pressure/Temperature Indication, General
Transmission Pressure/Temperature Indication
Transmission Oil Pressure Transmitter
Gearbox Oil Pressure/Temperature Indicator
NOC

1519 (1) Transmission Tachometer Indication, General
Transmission Tachometer Indicator

1520 (7) Fuel Quantity Indicators, General
Fuel Quantity Indicators
Fuel Quantity Indicator

1521 (5) Fuel System Indicating Components, General
Fuel System Indicating Components
Fuel Quantity Tank Unit
Low Level Switch

1522 (4) Instruments, Other

1601 (2) CN1141/ASN75 Displacement Gyro
1602 (7) MD1 Vertical Gyro
1603 (4) Flight Reference, Other
ML-1 Compass Transmitter

1701 (17) AN/ARC94/102/119/120 Radio Set, General
AN/ARC 94/102/119/120 Radio Set
RT 648/ARC 94 Receiver-Transmitter
Main Chassis Wiring Harness (ARC 94)
Antenna Coupler
Antenna
RT 698/ARC 102 Receiver-Transmitter
NOC

1702 (9) AN/ARC 131 VHF-FM Radio Set, General
AN/ARC 131 VHF-FM Radio Set
RT 823/ARC 131 Receiver-Transmitter
NOC

1703 (8) HF Communications System, Other
HF Communications System
HF Long Wire Antenna
J 562/AR Terminal Box
AT 455/ARC Antenna Element

AT 624/AR Antenna Element
NOC

1801 (32) AN/ARC 114 Radio Set, General
AN/ARC 114 Radio Set
NOC

1802 (7) AN/ARC 115 Radio Set, General
AN/ARC 115 Radio Set
NOC

1803 (6) VHF Communications, Other
VHF Communications
RT 348/ARC 54 Receiver-Transmitter
C3835/ARC 54 Control Unit
Antenna Coupler
AS 1703/AR Antenna
NOC

1901 (4) AN/ARC 27 Radio Set, General
AN/ARC 27 Radio Set

1902 (14) AN/ARC 51 Radio Set, General
AN/ARC 51 Radio Set
RT 650/ARC 51 Receiver-Transmitter
C6555/ARC 51A Control Unit
RT 742/ARC 51BX Receiver-Transmitter
RT 743/ARC 51A Receiver-Transmitter
RT 780/ARC 51AX Receiver-Transmitter
NOC

1903 (7) AN/ARC 52 Radio Set, General
AN/ARC 52 Radio Set
RT 332/ARC 52 Receiver-Transmitter
NOC

1904 (5) AN/ARC 55 Radio Set, General
AN/ARC 55 Radio Set
RT 349/ARC 55 Receiver-Transmitter

1905 (52) AN/ARC 116 Radio Set, General
AN/ARC 116 Radio Set
Radio Receiver/Control A1

1906 (84) UHF Communications System, Other
UHF Communications System
UHF Communications Associated Equipment
AT 741/A Antenna
AT 141/ARC Antenna
AT 450/ARC Antenna
NOC

2001 (12) AN/AIC 14 Intercommunications Set, General
- AN/AIC 14 Intercommunications Set
- C2642/AIC 14 Control Unit
- C2643/AIC 14 Control Unit
- MT2075/AIC 14 Mounting
- NOC

2002 (10) AN/AIC 18 Intercommunications Set, General
- AN/AIC 18 Intercommunications Set
- C2106/AIC 18 ICS Control

2003 (81) Interphone System, Other
- Interphone System
- Miscellaneous Interphone Equipment
- C2379/AIC Control Unit
- F90/AIC Noise Filter
- M1-23020 Microphone Adapter
- SA26/U Microphone Switch
- SA47A/AIC Microphone Switch
- CX 4620/AR Cord Set
- CX 4621/AR Cord Set
- CX 4623/AR Cord Set
- CX 4632/AR Cord Set
- CX 4622/AR Coil Cord
- C6533/ARC Comm Systems Control
- NOC

2101 (29) IFF Systems, General
- IFF Systems
- AN/APA 89 SIF Coder Group
- RT 82/APX6 Receiver-Transmitter
- AN/APX 72 Transponder Set
- RT 859/APX 72 Receiver-Transmitter
- Impedance Matching Network
- AT 884/APX Antenna
- TS 1843/APX Transponder Test Set
- NOC

2201 (111) AN/ARN 52 (V) TACAN Set, General
- AN/ARN 52 (V) TACAN Set
- RT 384/ARN 52 Receiver-Transmitter
- Bearing B Module (RT 384)
- C2010/ARN 52 Control Unit
- MT 1729/ARN 52 Mount
- Lower Antenna
- C7712/ARN 52 (V) Control
- Fan Assembly (Blower)
- NOC

2202 (35) AN/ARN 59 Direction Finder Set, General
- AN/ARN 59 Direction Finder Set
- R836/ARN Receiver

C2275/ARN Control Unit
AT 780/ARN Antenna

2203 (12) Radio Navigation, Other
ID 322/ARN 30 Indicator
AS 580A/ARN 30 Antenna
AN/ARN 83 Direction Finder Set
R1391/ARN 83 Receiver
C6899/ARN 83 Control
NOC

2301 (26) Radar Navigation, General
AN/APN 171 (V) Radar Altimeter Set
R1829/APN 171 (V) Receiver-Transmitter
ID 1345/APN 171 (V) Indicator
AS 1858/APN 171 (V) Antenna
RT 804/APN 171 (V) Receiver-Transmitter
RT 805/APN 171 (V) Receiver-Transmitter
NOC

2401 (3) Weapon Delivery, General
Aero 65A1 Bomb Rack Release Assembly
External Stores Control/Equipment
Armament Control Box

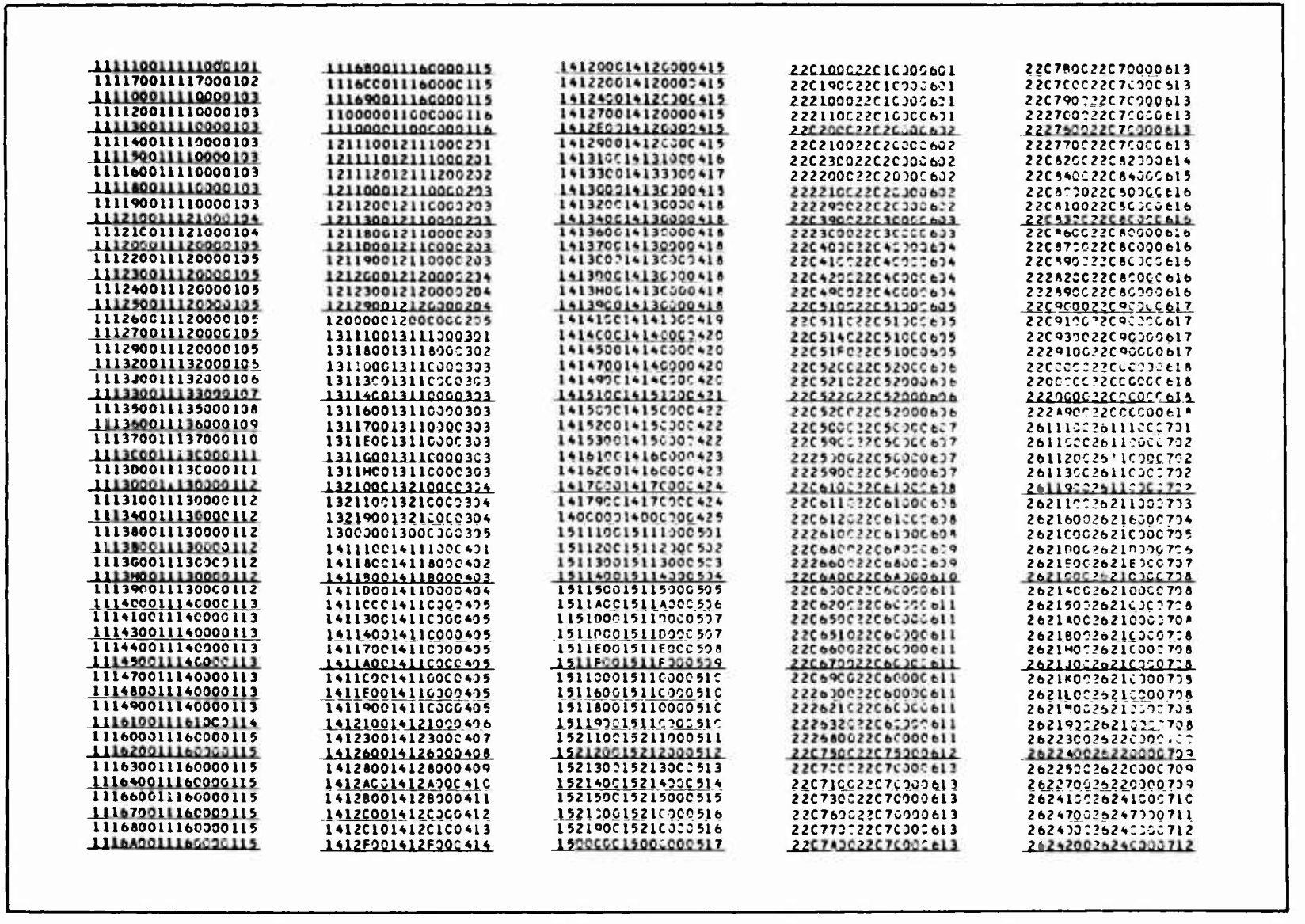
2501 (35) Emergency Equipment, General
Emergency Equipment
Fire Fighting Equipment
Portable CO_2 Fire Extinguisher
First Aid Kit
NOC

APPENDIX III
ELEMENT NUMBER-WORK UNIT CODE
CROSS REFERENCE INDEX

The following pages contain a listing of the data cards that formed the EN-WUC CRI developed to process Navy 3M-MDCS data on the UH-1N for use in an O and M simulation model. The CRI relates Navy WUC in the data to an Element WUC and associated Element Number. The first two digits of the EN represent a system designation and the last two digits the element within the system. The CRI developed is typical of a step required to process another Navy aircraft or an aircraft from a different service for O and M simulation-model input.

The CRI contains the Navy Work Unit Code (NWUC) assigned to a part in the UH-1N breakdown in columns 1-7, an associated Element Work Unit Code (EWUC) in columns 8-14, and the designated Element Number (EN) — for each EWUC — in columns 15-18.

When NWUC'd parts are amalgamated to form a single element, the appropriate next higher-level WUC is designated as the EWUC. When a single part is identified as an element, there is a unique relationship between NWUC, EWUC, and EN.



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APPENDIX IV
ELEMENT DATA-TAPE LAYOUT, TABULATION BY NAVY WDC, ATC, AND WCC

The following layout description defines the content of maintenance-data records tabulated for each UH-IN Element in magnetic-tape output from Job 6, Step 5, in the aircraft Historical Data Tabulation portion of the component evaluation and ranking algorithm.

A sample extract of data in this output format is included in the report as Figure 5. Data are right-hand-justified and filled to the left with O's; EMT and MH are in tenths.

Record Column	Description
Identifier Information	
1–4	EN
5–11	EWUC
On-aircraft Navy WDC counts	
12–14	A
15–17	B
18–20	C
21–23	D
24–26	E
27–29	F
30–32	G
33–35	H
36–38	J
39–41	K
42–44	M
45–47	N
48–50	P
51–53	Q
54–56	R
57–59	U
60–62	W
63–65	X
66–68	Y
69–71	Other
On-aircraft Navy ATC counts	
72–74	A
75–77	B
78–80	C

81—83	D
84—86	J
87—89	K
90—92	L
93—95	M
96—98	N
99—101	P
102—104	Q
105—107	R
108—110	S
111—113	T
114—116	U
117—119	Y
120—122	Z
123—125	Other
On-aircraft Navy WCC counts	
126—128	100
129—131	11X
132—134	12X
135—137	13X
138—140	14X
141—143	200
144—146	21X
147—149	22X
150—152	300
153—155	31X
156—158	32X
159—161	Other
162—167	Total EMT for on-aircraft ATC's P, Q, R, S, T, and U
168—173	Total EMT for on-aircraft ATC's A, B, C, D, J, K, L, M, N, Y, Z, and Other
174—180	Total MH for on-aircraft ATC's P, Q, R, S, T, and U
181—187	Total MH for on-aircraft ATC's A, B, C, D, J, K, L, M, N, Y, Z, and Other
Off-Equipment Navy ATC counts	
188—190	1
191—193	2
194—196	3
197—199	4
200—202	5

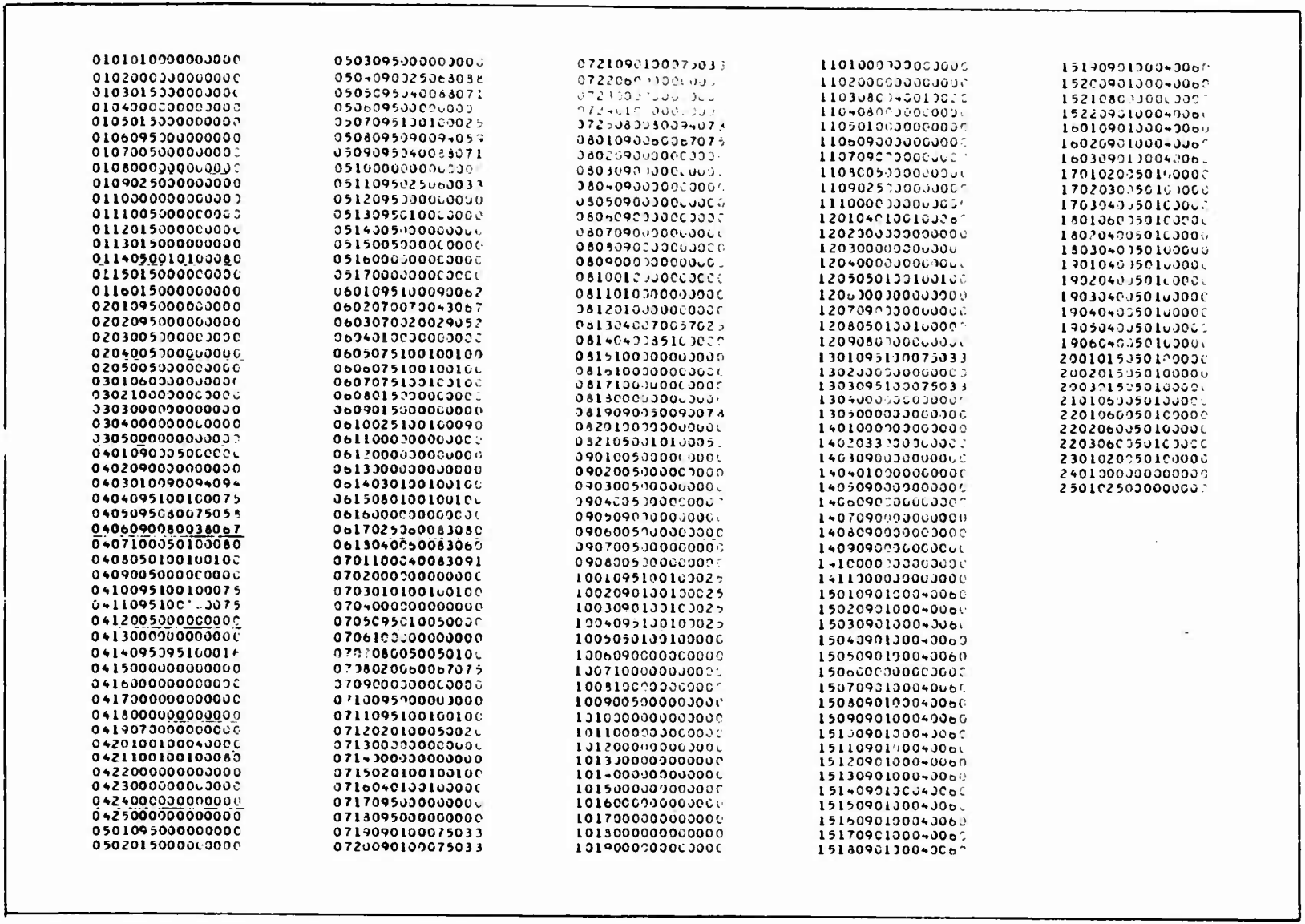
203–205	6
206–208	7
209–211	8
212–214	9
215–217	A
218–220	B
221–223	C
224–226	D
227–229	J
230–232	K
233–235	L
236–238	M
239–241	N
242–244	Other
Off-Equipment Navy WCC counts	
245–247	400
248–250	41X
251–253	44X
254–256	45X
257–259	500
260–262	51X
263–265	52X
266–268	53X
269–271	54X
272–274	55X
275–277	56X
278–280	57X
281–283	600
284–286	61X
287–289	62X
290–292	7XX
293–295	8XX
296–298	9XX
299–301	Other
302–307	Total EMT for off-equipment ATC's 1, 2, 3, 4, 5, 6, 7, 8, and 9
308–313	Total EMT for off-equipment ATC's A, B, C, D, J, K, L, M, N, and Other
314–320	Total MH for off-equipment ATC's 1, 2, 3, 4, 5, 6, 7, 8, and 9
321–327	Total MH for off-equipment ATC's A, B, C, D, J, K, L, M, N, and Other

APPENDIX V
UH-1N ELEMENT ARMY MAINTENANCE PROBABILITIES

The following list describes the UH-1N element maintenance probabilities that were inputted to the R and M function calculation program in Job 9 to adjust Navy/Marine historical data to reflect an Army maintenance scenario.

The following information is inputted in the first 16 columns of 80-column data cards:

- EN — Element Number (Columns 1-4)
- P_1 — Probability of removal and replacement given a maintenance action (Columns 5-7)
- P_2 — Probability of shipment from O-IDSM to DS given removal and replacement (Columns 8-10)
- P_3 — Probability of shipment from DS to GS given receipt in DS (Columns 11-13)
- P_4 — Probability of shipment from GS to Depot given receipt in GS (Columns 14-16)



APPENDIX VI
DEVELOPMENT OF R AND M INPUT DATA FOR ALTERNATE MAIN ROTOR BLADES

The following summary describes the approach taken to develop R and M data for the alternate main rotor blades (MRB) that would replace the UH-1N MRB data in the O and M simulation.

The types of data developed and the approach are generally typical of what would be required for any component under analysis.

MRB MAINTENANCE-ACTION RATE AND DISTRIBUTION

The UH-1N MRBs experienced eleven MAs in the historical data period covering 11,804 flying hours (FH). The MAs were distributed in when-discovered periods as shown in Table V of this report. As indicated in the discussion of Job 10 in the Component Evaluation and Ranking section of the report, the UH-1N MRB was removed and replaced by the UH-1H MRB (in the form of R and M data) to form the baseline aircraft, and successively by alternate MRBs I, II, III, and IV to form alternate-configuration aircraft.

UH-1H and alternate MRB data were developed from Reference 1. Only externally induced incidents were considered for these MRBs since inherent failure rates were not presented for the different configurations. Briefly, the alternate MRB designs were:

- I — Repairable blade with current UH-1 structural components
- II — Repairable blade with aluminum spar
- III — Repairable blade with composite-material spar
- IV — Repairable blade with titanium spar

The number of incident exposures applied in common to all five blade configurations was 1,000 per 10^6 blade hours, or 0.001 exposure per blade hour and 0.002 exposure per FH in the two-bladed helicopter used. The probabilities of an exposure resulting in an MA, from Table II in Reference 1, were:

- Current UH-1H (C) — 71/100
- Alternate I — 71/100
- Alternate II — 69/100
- Alternate III — 71/100
- Alternate IV — 70/100

Therefore, the following MAs were introduced for each of the five MRB configurations in the 11,804 data base:

- C, I, III — 0.002 * 71/100 * 11,804 = 16.76
- II — 0.002 * 69/100 * 11,804 = 16.29
- IV — 0.002 * 70/100 * 11,804 = 16.52

Distributions of the conditions under which, or the periods when, the MA requirements were discovered were developed through analysis of Appendixes I and II of Reference 1. (Types of incident frequencies below 20/100 were not considered significant in our analysis.) The results of this analysis are summarized in Table XI for the UH-1H MRB. Similar analyses were performed for the four alternate MRBs; the results were shown in Table V.

The data on the five MRB configurations provide the necessary information to change the historical data base for calculation of the aircraft and system-level functions indicated in Job 10, Step 1, and the element-level function changes attributed to the MRB (EN 0504) replacement through Function 35 in Job 10, Step 2.

MRB REMOVE AND REPLACE AND WHERE-REPAIRED PROBABILITIES

Remove and replace and where-repaired probabilities were developed for the UH-1H and alternate MRBs by using Table II of Reference 1 and the Army maintenance scenario probabilities shown in Appendix V for EN 0504:

- Percent remove and replace equals percent Intermediate repair plus percent Depot repair plus percent scrap:

$$C = 14.1 + 14.1 + 54.9 = 83.1 \text{ percent}$$
$$I = 50.7 + 8.5 + 19.7 = 78.9 \text{ percent}$$
$$II = 58.0 + 8.7 + 17.4 = 84.1 \text{ percent}$$
$$III = 50.7 + 12.7 + 18.3 = 81.7 \text{ percent}$$
$$IV = 64.3 + 11.4 + 17.2 = 92.9 \text{ percent}$$

- Percent NRTS (1—8) given removal and replacement — assuming scrappage at General Support level — equals number Depot-repaired divided by number Intermediate-repaired plus number Depot-repaired plus number scrapped:

$$C = \frac{10}{10 + 10 + 39} \times 100 = 16.9 \text{ percent}$$

$$I = \frac{6}{36 + 6 + 14} \times 100 = 10.7 \text{ percent}$$

$$II = \frac{9}{40 + 6 + 12} \times 100 = 10.3 \text{ percent}$$

$$III = \frac{9}{36 + 9 + 13} \times 100 = 15.5 \text{ percent}$$

$$IV = \frac{8}{45 + 8 + 12} \times 100 = 12.3 \text{ percent}$$

TABLE XI. CURRENT UH-1H MRB MA DISTRIBUTION

Part I — MA Allocation Determination

MRB Part Name	Maintenance Action per 10^6 Bl. Hr.	Incident Description	Estimate of When-Discovered and NOR/Abort Input	Portion of MA Total
Skin	280.00	Strike, slight degradation, vibration, scrap	In-flight, no abort	$\frac{280}{915} * 16.76 = 5.13$
Skin	198.00	Strike, slight degradation, vibration, depot repair	In-flight, no abort	3.62
Core	136.00	Slight degradation, complete mission, visual, scrap	Preflight, NOR	2.49
Abrasive Strip	62.90	No mission effect, repair on aircraft	Periodic Inspection	1.15
Core	50.00	Slight degradation, complete mission, visual, field repair	Preflight, NOR	0.92
Abrasive Strip	49.00	No mission effect, visual, depot repair	Preflight, NOR	0.90
Overall Blade (RPM)	33.07	RPM above limit, complete mission, scrap	In-flight, no abort	0.60
Box beam and Doubler	32.00	Projectile, forced landing, vibration	In-flight, abort	0.59
Spline	26.00	Crack, return to base or forced landing	In-flight, abort	0.48
Box Beam and Doubler	25.60	May cause forced landing, vibration	In-flight, abort	0.48
Spline	22.00	Slight increase in turbulence, complete mission	In-flight, no abort	0.40
Total Actions	915		Total MA's	16.76

(continued)

TABLE XI — Continued

Part II — MA Distribution

MRB Part Name	In Flight	Preflight	Daily	Periodic	In Flight Abort	In Flight No Abort NOR	Preflight NOR	Daily NOR
Skin	5.13					5.13		
Skin	3.62					3.62		
Core		2.49					2.49	
Abrasive Strip				1.15				
Core		0.92					0.92	
Abrasive Strip		0.90					0.90	
Overall Blade (RPM)	0.60					0.60		
Box Beam and Doubler	0.59				0.59			
Spline	0.48				0.48			
Box Beam and Doubler	0.48				0.48			
Spline	0.40					0.40		
Subtotals	11.30	4.31	0	1.15	1.55	9.75	4.31	0
Total MAs		16.76						

- Percent NRTS (1—9) given removal and replacement equals the NRTS (1—8) calculation with the numerator increased by the number scrapped:

$$C = \frac{10 + 39}{10 + 10 + 39} \times 100 = 83.1 \text{ percent}$$

$$I = \frac{6 + 14}{36 + 6 + 14} \times 100 = 35.7 \text{ percent}$$

$$II = \frac{6 + 12}{40 + 6 + 12} \times 100 = 31.0 \text{ percent}$$

$$III = \frac{9 + 13}{36 + 9 + 13} \times 100 = 37.9 \text{ percent}$$

$$IV = \frac{8 + 12}{45 + 8 + 12} \times 100 = 30.8 \text{ percent}$$

- Percent Organizational (IDSM)-repaired given removal and replacement, percent Direct Support-repaired given receipt, and percent General Support repaired given receipt are calculated as described under Functions 37 and 52 in the Simulation Model R and M Input section of the report by using P_5 (percent NRTS [1—9] given an MA) and P_1 (percent remove and replace) calculated from Table II, Reference 1, P_2, P_3, and P_4 determined from the Army maintenance distribution for EN 0504 (shown in Appendix V of this report):

	P_5	P_1	P_2	P_3	P_4
C	$\frac{49}{71} \times 100 = 69.0$	83.1	25	17	15
I	$\frac{20}{71} \times 100 = 28.2$	78.9	25	17	15
II	$\frac{18}{69} \times 100 = 26.1$	84.1	25	17	15
III	$\frac{22}{71} \times 100 = 31.0$	81.7	25	17	15
IV	$\frac{20}{70} \times 100 = 28.6$	92.9	25	17	15

	Percent O (IDSM) Repaired Given R&R	Percent DS Repaired Given Receipt	Percent GS Repaired Given Receipt
C	12.8	4.1	0.7
I	48.5	26.1	6.1
II	52.0	30.0	7.6
III	46.8	24.4	5.7
IV	52.2	30.3	7.6

MRB SKILL CODES – WORK CENTER DESIGNATIONS

Primary and secondary on-equipment work centers and primary off-equipment shop designations identified in Job 9, Step 3, as being applicable to the UH-1N MRB (EN 0504 in Figure 7) appeared reasonable for all of the MRBs based on work-center definitions in Table IV of this report:

MRB Codes	Work-Center Codes		
	Off-Equipment Primary	On-Equipment Secondary	On-Equipment Primary
C	06	03	01
I	06	03	01
II	06	03	01
III	06	03	01
IV	06	03	01

MRB MANPOWER (MPR) AND ELAPSED MAINTENANCE TIME (EMT) EXPENDITURES

MPR and EMT data required for simulation-model input on the five MRB were determined through a review of pages 47 through 49 and Table IV of Reference 1. In the case of MRB on-aircraft MEMT, the value must reflect the all-inclusive active downtime; this involves any curing times, etc. Also, for proper MPR expenditure accounting in the simulation, the input must reflect the mean number of men over the complete active-downtime period.

MRB	On-Aircraft				Off-Aircraft Repair	
	Repair in Place		Remove and Replace			
	MEMT	MPR*	MEMT	MPR*	MEMT	MPR
C	2.30	$\frac{0.40}{2.30} \times 1 = 0.17$	3.73	2.0	1.60	1.0
I	1.98	$\frac{0.64}{1.98} \times 1 = 0.32$	3.73	2.0	4.50	1.0
II	2.91	$\frac{0.73}{2.91} \times 1 = 0.25$	3.73	2.0	3.98	1.0
III	3.10	$\frac{0.68}{3.10} \times 1 = 0.22$	3.73	2.0	4.29	1.0
IV	5.20	$\frac{1.36}{5.20} \times 1 = 0.26$	3.73	2.0	4.95	1.0

*Manpower is proportioned between the primary and secondary work centers for on-aircraft equipment as discussed under Functions 42 and 54 in the R and M Input Calculation section of this report.

This last subsection of Appendix VI, together with the preceding two subsections, completes the summary of approaches used to calculate or modify the R and M input data for element Functions 37 through 54.

APPENDIX VII
LISTING OF GPSS R AND M FUNCTION DECK FOR MAIN ROTOR BLADE DEMONSTRATION EXERCISE

This appendix presents a complete R and M Function Deck listing in GPSS format; it was prepared for the MRB (EN 0504) demonstration exercise in which the current UH-1H MRB replaced the UH-1N MRB in the baseline aircraft and which in turn was replaced by four alternate MRB designs. The listing shows the baseline deck and four subdecks that are used to change the baseline deck when the alternate MRBs are incorporated.

Columns 76—80 of the standard data cards are used to identify function cards affected by component changes, function number, and card sequence in the function.

All function cards with an alpha or numeric character in column 76 are subject to change when alternate components are being considered. In the demonstration exercise, where the UH-1H MRB was used as the baseline component, a C in column 76 means that the card applies to the UH-1H MRB in the demonstration exercise. The codes in column 76 are interpreted as follows:

Column 76 Code	Definition
A	Card could be subject to change but no change required going from baseline (UH-1H) MRB to alternate; i.e., card applicable to All
C	Card applicable to baseline component in aircraft and must be changed to consider alternate components i.e, card applicable to Current MRB
1	Similar to C above except card applicable to Alternate I MRB (1)
2	Similar to C above except card applicable to Alternate II MRB (2)
3	Similar to C above except card applicable to Alternate III MRB (3)
4	Similar to C above except card applicable to Alternate IV MRB (4)

Columns 77—78 contain the function number and columns 79—80 the card sequence in the function. The baseline deck continues through Function 54, card 41, in the listing. The baseline deck is followed by the replacement-card subdecks for alternate MRBs I, II, III, and IV.

```
 2     FUNCTION    P17,D7        GROUND EVENT PROB OF SUCCESS
1     9999992     8902465     97447111     99999916     90308117     034447     C0201
21    987622                                                                    C0202
 3     FUNCTION    P8,D2         PROB OF NO MA DURING FLIGHT
0     7759391     775939                                                        C0301
 5     FUNCTION    P8,D2         PROB NO ABORT/MA DURING FLIGHT
0     9791861     979186                                                        C0501
 10    FUNCTION    RN1,D4        PROB MULT MA/MA DURING FLIGHT
0.87491     0.99042     0.99983     0.99994                                     C1001
 11    FUNCTION    RN1,D3        PROB MULT MA/MA DURING PREFLIGHT
0.94391     0.99872     0.99993                                               C1101
 12    FUNCTION    RN1,D3        PROB MULT MA/MA DURING DAILY
0.95091     0.99932     0.99993                                               C1201
 13    FUNCTION    RN1,D2        PROB MULT MA/MA DURING AIRCREW
0.99101     0.99992                                                           A1301
 14    FUNCTION    RN1,D11       PROB MULT MA/MA DURING PERIODIC
0.12021     0.32262     0.54983     0.74124     0.87015     0.94256           C1401
0.97737     0.99208     0.99759     0.999310    0.999911                      C1402
 16    FUNCTION    RN1,D21       PROB SYSTEM MA AIRCREW/MA AIRCREW
0.180201    0.189202    0.207203    0.252304    0.342305    0.531506          A1601
0.617107    0.716208    0.725209    0.842310    0.878411    0.891912          A1602
0.905413    0.914414    0.936915    0.955019    0.959520    0.968522          A1603
0.973023    0.977524    0.999925                                              A1604
 17    FUNCTION    RN1,D25       PROB SYSTEM MA IN-FLIGHT/MA IN-FLIGHT
0.036101    0.049102    0.055603    0.132204    0.177505    0.278906          C1701
0.313707    0.386909    0.392909    0.523610    0.585711    0.596812          C1702
0.611313    0.625814    0.762115    0.766616    0.774117    0.794618          C1703
0.865319    0.905820    0.916321    0.985022    0.996523    0.997024          C1704
0.999925                                                                      C1705
 18    FUNCTION    RN1,D11       PROB SYSTEM MA ABORT IN-FLIGHT/ABT IN-FLT
0.024102    0.048103    0.096304    0.181705    0.494606    0.687107          C1801
0.831510    0.855612    0.879715    0.975919    0.999920                      C1802
 19    FUNCTION    RN1,D25       PROB SYSTEM MA PREFLIGHT/MA PREFLIGHT
0.245501    0.270602    0.311503    0.373804    0.492205    0.575006          C1901
0.637307    0.729408    0.743309    0.815910    0.844711    0.871712          C1902
0.880013    0.896814    0.919115    0.921016    0.930317    0.934018          C1903
0.950719    0.967520    0.973021    0.983322    0.984223    0.985124          C1904
0.999925                                                                      C1905
 20    FUNCTION    RN1,D21       PROB SYSTEM MA DAILY/MA DAILY
0.299801    0.324402    0.384803    0.434004    0.550305    0.668906          C2001
0.740507    0.823308    0.843409    0.883710    0.903811    0.932912          C2002
0.955313    0.968714    0.970915    0.973216    0.979917    0.984320          C2003
0.988821    0.991122    0.999925                                              C2004
 21    FUNCTION    RN1,D22       PROB SYSTEM MA PERIODIC/MA PERIODIC
0.269601    0.286002    0.329603    0.446704    0.547905    0.605106          C2101
0.692207    0.782108    0.790309    0.847510    0.872011    0.893812          C2102
0.907413    0.923714    0.937415    0.940116    0.956417    0.964619          C2103
0.967320    0.986422    0.989123    0.999925                                  C2104
 22    FUNCTION    P3,L25        NUMBER OF ELEMENTS IN SYSTEMS
01   16   02   5    03   5    04   25   05   17   06   18                     2201
07   25   08   21   09   8    10   19   11   10   12   9                      2202
13   5    14   11   15   22   16   3    17   3    18   3                      2203
19   6    20   3    21   1    22   3    23   1    24   1                      2204
```

'5	1											2205
24	FUNCTION		FN46,L241		PROB	ELEMENT	MA	AIRCREW/MA	SYS	AIRCREW		
0101	025	0102	000	0103	050	0104	025	0105	050	0106	150	2401
0107	125	0108	050	0109	050	0110	075	0111	100	0112	000	2402
0113	075	0114	100	0115	075	0116	050	0201	000	0202	999	2403
0203	000	0204	000	0205	000	0301	250	0302	250	0303	250	2404
0304	250	0305	000	0401	000	0402	200	0403	000	0404	000	2405
0405	000	0406	000	0407	000	0408	000	0409	000	0410	000	2406
0411	100	0412	000	0413	000	0414	000	0415	200	0416	200	2407
0417	000	0418	100	0419	100	0420	000	0421	100	0422	000	2408
0423	000	0424	000	0425	000	0501	200	0502	100	0503	000	A2409
0504	000	0505	000	0506	150	0507	250	0508	000	0509	000	A2410
0510	250	0511	000	0512	000	0513	350	0514	000	0515	000	A2411
0516	000	0517	000	0601	000	0602	000	0603	000	0604	000	A2412
0605	071	0606	095	0607	214	0608	048	0609	000	0610	000	2413
0611	143	0612	048	0613	214	0614	071	0615	000	0616	071	2414
0617	000	0618	024	0701	105	0702	000	0703	053	0704	105	2415
0705	000	0706	000	0707	000	0708	158	0709	000	0710	000	2416
0711	000	0712	053	0713	053	0714	053	0715	053	0716	105	2417
0717	053	0718	053	0719	053	0720	000	0721	000	0722	000	2418
0723	000	0724	105	0725	000	0801	000	0802	091	0803	136	2419
0804	000	0805	000	0806	091	0807	000	0808	091	0809	000	2420
0810	000	0811	045	0812	273	0813	000	0814	000	0815	045	2421
0816	045	0817	045	0818	136	0819	000	0820	000	0821	000	2422
0901	500	0902	000	0903	000	0904	500	0905	000	0906	000	2423
0907	000	0908	000	1001	077	1002	038	1003	000	1004	192	2424
1005	192	1006	231	1007	038	1008	077	1009	077	1010	000	2425
1011	000	1012	000	1013	000	1014	038	1015	000	1016	038	2426
1017	000	1018	000	1019	000	1101	375	1102	000	1103	125	2427
1104	000	1105	000	1106	000	1107	125	1108	000	1109	375	2428
1110	000	1201	000	1202	333	1203	000	1204	000	1205	000	2429
1206	000	1207	667	1208	000	1209	000	1301	000	1302	333	2430
1303	333	1304	000	1305	333	1401	000	1402	500	1403	000	2431
1404	500	1405	000	1406	000	1407	000	1408	000	1409	000	2432
1410	000	1411	000	1501	200	1502	000	1503	000	1504	200	2433
1505	000	1506	000	1507	000	1508	000	1509	200	1510	200	2434
1511	000	1512	200	1513	000	1514	000	1515	000	1516	000	2435
1517	000	1518	000	1519	000	1520	000	1521	000	1522	000	2436
1601	000	1602	000	1603	000	1701	000	1702	000	1703	000	2437
1801	000	1802	000	1803	000	1901	000	1902	000	1903	000	2438
1904	000	1905	750	1906	250	2001	000	2002	000	2003	999	2439
2101	000	2201	999	2202	000	2203	000	2301	999	2401	999	2440
2501	999											2441
25	FUNCTION		FN46,L241		PROB	ELEMENT	MA	IN-FLIGHT/MA	SYS	IN-FLT		
0101	014	0102	028	0103	097	0104	069	0105	056	0106	097	2501
0107	069	0108	000	0109	111	0110	042	0111	028	0112	097	2502
0113	042	0114	056	0115	111	0116	083	0201	192	0202	269	2503
0203	462	0204	038	0205	038	0301	308	0302	385	0303	154	2504
0304	154	0305	000	0401	078	0402	026	0403	000	0404	020	2505
0405	203	0406	046	0407	000	0408	007	0409	039	0410	105	2506
0411	007	0412	020	0413	000	0414	020	0415	046	0416	039	2507
0417	033	0418	124	0419	059	0420	020	0421	000	0422	039	2508
0423	000	0424	013	0425	059	0501	055	0502	310	0503	011	C2509

0504	125	0505	000	0506	033	0507	022	0508	000	0509	011	C2510
0510	244	0511	011	0512	011	0513	011	0514	011	0515	011	C2511
0516	033	0517	100	0601	045	0602	030	0603	005	0604	000	C2512
0605	054	0606	050	0607	084	0608	084	0609	050	0610	079	2513
0611	030	0612	025	0613	089	0614	158	0615	074	0616	074	2514
0617	000	0618	069	0701	014	0702	043	0703	086	0704	086	2515
0705	014	0706	000	0707	014	0708	100	0709	043	0710	029	2516
0711	000	0712	100	0713	057	0714	071	0715	000	0716	086	2517
0717	000	0718	014	0719	000	0720	043	0721	043	0722	000	2518
0723	014	0724	143	0725	000	0801	007	0802	048	0803	027	2519
0804	007	0805	014	0806	007	0807	007	0808	021	0809	000	2520
0810	021	0811	281	0812	336	0813	123	0814	055	0815	014	2521
0816	014	0817	000	0818	007	0819	000	0820	000	0821	014	2522
0901	167	0902	583	0903	000	0904	083	0905	083	0906	000	2523
0907	000	0908	083	1001	077	1002	023	1003	054	1004	096	2524
1005	069	1006	314	1007	077	1008	126	1009	050	1010	034	2525
1011	011	1012	004	1013	004	1014	000	1015	004	1016	011	2526
1017	034	1018	000	1019	011	1101	032	1102	089	1103	024	2527
1104	194	1105	234	1106	121	1107	081	1108	097	1109	121	2528
1110	008	1201	136	1202	045	1203	091	1204	000	1205	273	2529
1206	227	1207	091	1208	136	1209	000	1301	345	1302	069	2530
1303	379	1304	138	1305	069	1401	138	1402	034	1403	103	2531
1404	172	1405	172	1406	069	1407	207	1408	000	1409	000	2532
1410	034	1411	069	1501	088	1502	251	1503	037	1504	184	2533
1505	051	1506	004	1507	066	1508	029	1509	033	1510	044	2534
1511	055	1512	029	1513	048	1514	037	1515	110	1516	051	2535
1517	004	1518	076	1519	004	1520	018	1521	018	1522	011	2536
1601	000	1602	667	1603	333	1701	333	1702	660	1703	067	2537
1801	683	1802	171	1803	146	1901	028	1902	085	1903	050	2538
1904	035	1905	376	1906	475	2001	111	2002	111	2003	778	2539
2101	999	2201	723	2202	219	2203	058	2301	999	2401	999	2540
2501	999											2541

26	FUNCTION		FN46,L241		PROB	ELEMENT	MA	ABORT	IN-FLIGHT/SY		ABT FLT	
0101	000	0102	000	0103	000	0104	000	0105	000	0106	000	2601
0107	000	0108	000	0109	000	0110	000	0111	000	0112	000	2602
0113	000	0114	000	0115	000	0116	000	0201	000	0202	000	2603
0203	999	0204	000	0205	000	0301	000	0302	999	0303	000	2604
0304	000	0305	000	0401	000	0402	000	0403	000	0404	000	2605
0405	000	0406	000	0407	000	0408	000	0409	000	0410	000	2606
0411	000	0412	000	0413	000	0414	500	0415	000	0416	000	2607
0417	000	0418	000	0419	500	0420	000	0421	000	0422	000	2608
0423	000	0424	000	0425	000	0501	000	0502	282	0503	000	C2609
0504	437	0505	000	0506	000	0507	000	0508	000	0509	000	C2610
0510	000	0511	000	0512	000	0513	000	0514	000	0515	000	C2611
0516	000	0517	282	0601	000	0602	077	0603	000	0604	000	C2612
0605	154	0606	000	0607	154	0608	154	0609	000	0610	077	2613
0611	000	0612	077	0613	077	0614	000	0615	000	0616	077	2614
0617	000	0618	154	0701	000	0702	000	0703	125	0704	375	2615
0705	000	0706	000	0707	000	0708	000	0709	000	0710	000	2616
0711	000	0712	250	0713	000	0714	000	0715	000	0716	000	2617
0717	000	0718	000	0719	000	0720	125	0721	000	0722	000	2618
0723	000	0724	125	0725	000	0801	000	0802	000	0803	000	2619
0804	000	0805	000	0806	000	0807	000	0808	000	0809	000	2620

0810	000	0811	000	0812	000	0813	000	0814	000	0815	000	2621
0816	000	0817	000	0818	000	0819	000	0820	000	0821	000	2622
0901	000	0902	000	0903	000	0904	000	0905	000	0906	000	2623
0907	000	090A	000	1001	167	1002	000	1003	333	1004	000	2624
1005	000	1006	000	1007	167	1008	333	1009	000	1010	000	2625
1011	000	1012	000	1013	000	1014	000	1015	000	1016	000	2626
1017	000	1018	000	1019	000	1101	000	1102	000	1103	000	2627
1104	000	1105	000	1106	000	1107	000	1108	000	1109	000	2628
1110	000	1201	000	1202	000	1203	000	1204	000	1205	999	2629
1206	000	1207	000	1208	000	1209	000	1301	000	1302	000	2630
1303	000	1304	000	1305	000	1401	000	1402	000	1403	000	2631
1404	000	1405	000	1406	000	1407	000	1408	000	1409	000	2632
1410	000	1411	000	1501	000	1502	000	1503	000	1504	000	2633
1505	000	1506	000	1507	000	1508	000	1509	000	1510	000	2634
1511	000	1512	000	1513	999	1514	000	1515	000	1516	000	2635
1517	000	1518	000	1519	000	1520	000	1521	000	1522	000	2636
1601	000	1602	000	1603	000	1701	000	1702	000	1703	000	2637
1801	000	1802	000	1803	000	1901	000	1902	000	1903	000	2638
1904	000	1905	000	1906	999	2001	000	2002	000	2003	999	2639
2101	000	2201	000	2202	000	2203	000	2301	000	2401	000	2640
2501	000											2641

27 FUNCTION FN46,L241 P90B ELEMENT MA PREFLIGHT/MA SYS PREFLIGHT

0101	049	0102	023	0103	091	0104	023	0105	064	0106	064	2701
0107	008	0108	011	0109	076	0110	011	0111	064	0112	129	2702
0113	098	0114	042	0115	098	0116	155	0201	148	0202	111	2703
0203	407	0204	259	0205	074	0301	432	0302	136	0303	295	2704
0304	114	0305	091	0401	000	0402	000	0403	000	0404	000	2705
0405	119	0406	015	0407	060	0408	015	0409	015	0410	015	2706
0411	104	0412	104	0413	060	0414	030	0415	090	0416	015	2707
0417	030	0418	164	0419	030	0420	015	0421	075	0422	015	2708
0423	030	0424	000	0425	030	0501	206	0502	016	0503	095	C2709
0504	034	0505	024	0506	119	0507	071	0508	008	0509	008	C2710
0510	245	0511	016	0512	000	0513	024	0514	008	0515	016	C2711
0516	103	0517	008	0601	034	0602	034	0603	011	0604	056	C2712
0605	079	0606	011	0607	045	0608	090	0609	056	0610	034	2713
0611	090	0612	101	0613	124	0614	067	0615	011	0616	079	2714
0617	056	0618	034	0701	045	0702	030	0703	119	0704	060	2715
0705	045	0706	000	0707	000	0708	090	0709	015	0710	045	2716
0711	000	0712	060	0713	015	0714	000	0715	030	0716	015	2717
0717	045	0718	075	0719	045	0720	075	0721	090	0722	015	2718
0723	030	0724	090	0725	015	0801	020	0802	141	0803	091	2719
0804	061	0805	162	0806	162	0807	040	0808	061	0809	000	2720
0810	010	0811	030	0812	071	0813	030	0814	000	0815	000	2721
0816	030	0817	030	0818	051	0819	010	0820	010	0821	000	2722
0901	133	0902	133	0903	467	0904	067	0905	000	0906	133	2723
0907	067	0908	000	1001	013	1002	051	1003	090	1004	051	2724
1005	282	1006	115	1007	115	1008	000	1009	090	1010	026	2725
1011	000	1012	000	1013	038	1014	000	1015	013	1016	000	2726
1017	038	1018	013	1019	077	1101	097	1102	032	1103	065	2727
1104	000	1105	097	1106	032	1107	323	1108	129	1109	194	2728
1110	032	1201	034	1202	103	1203	172	1204	034	1205	207	2729
1206	276	1207	069	1208	034	1209	069	1301	000	1302	111	2730
1303	889	1304	000	1305	000	1401	167	1402	167	1403	000	2731

1405	167	1405	056	1406	111	1407	222	1408	056	1409	000	2732
1410	000	1411	000	1501	042	1502	083	1503	083	1504	125	2733
1505	000	1506	042	1507	083	1508	000	1509	042	1510	083	2734
1511	083	1512	000	1513	000	1514	000	1515	167	1516	042	2735
1517	000	1518	042	1519	000	1520	083	1521	000	1522	042	2736
1601	500	1602	000	1603	500	1701	600	1702	000	1703	400	2737
1801	999	1802	000	1803	000	1901	000	1902	056	1903	000	2738
1904	000	1905	167	1906	778	2001	111	2002	000	2003	889	2739
2101	999	2201	545	2202	273	2203	182	2301	999	2401	999	2740
2501	999											2741

28 FUNTION FN46•L241 PROB ELEMENT MA DAILY/MA SYS DAILY

0101	037	0102	022	0103	082	0104	030	0105	067	0106	022	2801
0107	007	0108	015	0109	067	0110	007	0111	037	0112	127	2802
0113	097	0114	052	0115	104	0116	149	0201	273	0202	091	2803
0203	364	0204	182	0205	091	0301	556	0302	222	0303	148	2804
0304	037	0305	037	0401	000	0402	000	0403	000	0404	000	2805
0405	091	0406	000	0407	000	0408	045	0409	045	0410	000	2806
0411	136	0412	136	0413	045	0414	045	0415	045	0416	000	2807
0417	000	0418	227	0419	045	0420	000	0421	045	0422	045	2808
0423	000	0424	000	0425	045	0501	192	0502	038	0503	019	C2809
0504	000	0505	038	0506	135	0507	077	0508	038	0509	000	C2810
0510	269	0511	019	0512	000	0513	019	0514	000	0515	019	C2811
0516	115	0517	019	0601	038	0602	019	0603	000	0604	057	C2812
0605	075	0606	075	0607	151	0608	075	0609	038	0610	019	2813
0611	057	0612	075	0613	170	0614	019	0615	000	0616	057	2814
0617	038	0618	038	0701	063	0702	031	0703	063	0704	063	2815
0705	031	0706	000	0707	000	0708	063	0709	000	0710	000	2816
0711	000	0712	063	0713	000	0714	000	0715	031	0716	031	2817
0717	063	0718	063	0719	031	0720	125	0721	094	0722	000	2818
0723	000	0724	031	0725	063	0801	027	0802	189	0803	081	2819
0804	000	0805	135	0806	054	0807	054	0808	054	0809	000	2820
0810	000	0811	027	0812	054	0813	027	0814	000	0815	000	2821
0816	027	0817	054	0818	135	0819	027	0820	000	0821	000	2822
0901	111	0902	222	0903	556	0904	000	0905	000	0906	111	2823
0907	000	0908	000	1001	000	1002	056	1003	111	1004	000	2824
1005	444	1006	000	1007	000	1008	000	1009	111	1010	000	2825
1011	000	1012	000	1013	056	1014	000	1015	056	1016	000	2826
1017	056	1018	000	1019	111	1101	000	1102	111	1103	000	2827
1104	000	1105	111	1106	111	1107	222	1108	111	1109	333	2828
1110	000	1201	154	1202	231	1203	154	1204	077	1205	000	2829
1206	154	1207	077	1208	000	1209	077	1301	100	1302	600	2830
1303	300	1304	000	1305	000	1401	167	1402	167	1403	000	2831
1404	167	1405	000	1406	167	1407	167	1408	167	1409	000	2832
1410	167	1411	000	1501	000	1502	000	1503	000	1504	000	2833
1505	000	1506	000	1507	000	1508	000	1509	000	1510	000	2834
1511	000	1512	000	1513	000	1514	000	1515	000	1516	000	2835
1517	000	1518	999	1519	000	1520	000	1521	000	1522	000	2836
1601	999	1602	000	1603	000	1701	333	1702	000	1703	667	2837
1801	000	1802	000	1803	000	1901	000	1902	000	1903	000	2838
1904	000	1905	000	1906	000	2001	000	2002	500	2003	500	2839
2101	999	2201	999	2202	000	2203	000	2301	000	2401	000	2840
2501	999											2841

29 FUNCTION FN46•L241 PROB ELEMENT MA PERIODIC/MA SYS PERIODIC

0101	030	0102	010	0103	131	0104	020	0105	081	0106	071	2901
0107	010	0108	051	0109	030	0110	010	0111	020	0112	101	2902
0113	111	0114	081	0115	162	0116	091	0201	167	0202	167	2903
0203	500	0204	167	0205	000	0301	375	0302	250	0303	063	2904
0304	313	0305	000	0401	000	0402	047	0403	000	0404	000	2905
0405	070	0406	000	0407	000	0408	093	0409	047	0410	000	2906
0411	047	0412	163	0413	023	0414	000	0415	093	0416	000	2907
0417	000	0418	116	0419	116	0420	070	0421	000	0422	070	2908
0423	000	0424	000	0425	000	0501	146	0502	029	0503	029	C2909
0504	034	0505	029	0506	029	0507	146	0508	000	0509	000	C2910
0510	264	0511	059	0512	029	0513	000	0514	029	0515	059	C2911
0516	088	0517	029	0601	048	0602	048	0603	000	0604	095	C2912
0605	095	0606	000	0607	000	0608	095	0609	048	0610	048	2913
0611	095	0612	048	0613	095	0614	000	0615	048	0616	000	2914
0617	048	0618	048	0701	000	0702	000	0703	031	0704	031	2915
0705	031	0706	000	0707	000	0708	063	0709	000	0710	000	2916
0711	000	0712	063	0713	000	0714	000	0715	063	0716	063	2917
0717	063	0718	031	0719	250	0720	031	0721	125	0722	000	2918
0723	000	0724	031	0725	031	0801	000	0802	242	0803	273	2919
0804	030	0805	091	0806	030	0807	000	0808	030	0809	000	2920
0810	000	0811	030	0812	061	0813	000	0814	000	0815	030	2921
0816	030	0817	000	0818	061	0819	030	0820	000	0821	000	2922
0901	000	0902	000	0903	333	0904	000	0905	000	0906	333	2923
0907	000	0908	000	1001	000	1002	095	1003	048	1004	095	2924
1005	381	1006	000	1007	000	1008	048	1009	048	1010	000	2925
1011	000	1012	000	1013	000	1014	000	1015	000	1016	048	2926
1017	048	1018	000	1019	143	1101	000	1102	000	1103	000	2927
1104	000	1105	000	1106	111	1107	000	1108	222	1109	556	2928
1110	000	1201	125	1202	000	1203	125	1204	000	1205	125	2929
1206	375	1207	000	1208	125	1209	000	1301	200	1302	400	2930
1303	400	1304	000	1305	000	1401	000	1402	333	1403	000	2931
1404	167	1405	000	1406	000	1407	167	1408	000	1409	167	2932
1410	000	1411	000	1501	000	1502	200	1503	000	1504	200	2933
1505	000	1506	000	1507	000	1508	000	1509	000	1510	000	2934
1511	600	1512	000	1513	000	1514	000	1515	000	1516	000	2935
1517	000	1518	000	1519	000	1520	000	1521	000	1522	000	2936
1601	000	1602	999	1603	000	1701	833	1702	000	1703	167	2937
1801	000	1802	000	1803	000	1901	000	1902	333	1903	000	2938
1904	000	1905	000	1906	667	2001	999	2002	000	2003	000	2939
2101	000	2201	429	2202	286	2203	286	2301	999	2401	000	2940
2501	999											2941

30	FUNCTION	FN46,L241	PROB	ARCRW	GRD	AL	JRT/MA	DURING	AIRCREW	
0101	000	0102	000	0103	000	0104	000	0105	000	0106	000	3001
0107	000	0108	500	0109	000	0110	000	0111	000	0112	000	3002
0113	000	0114	000	0115	333	0116	000	0201	000	0202	999	3003
0203	000	0204	000	0205	000	0301	000	0302	000	0303	000	3004
0304	000	0305	000	0401	000	0402	500	0403	000	0404	000	3005
0405	000	0406	000	0407	000	0408	000	0409	000	0410	000	3006
0411	000	0412	000	0413	000	0414	000	0415	500	0416	000	3007
0417	000	0418	000	0419	000	0420	000	0421	000	0422	000	3008
0423	000	0424	000	0425	000	0501	000	0502	000	0503	000	3009
0504	000	0505	000	0506	333	0507	400	0508	000	0509	000	A3010
0510	000	0511	000	0512	000	0513	000	0514	000	0515	000	3011

0516	000	0517	000	0601	000	0602	000	0603	000	0604	000	3012
0605	000	0606	250	0607	222	0608	500	0609	000	0610	000	3013
0611	500	0612	000	0613	000	0614	667	0615	000	0616	667	3014
0617	000	0618	999	0701	000	0702	000	0703	000	0704	500	3015
0705	000	0706	000	0707	000	0708	000	0709	000	0710	000	3016
0711	000	0712	000	0713	000	0714	000	0715	000	0716	000	3017
0717	000	0718	000	0719	999	0720	000	0721	000	0722	000	3018
0723	000	0724	500	0725	000	0801	000	0802	500	0803	000	3019
0804	000	0805	000	0806	500	0807	000	0808	000	0809	000	3020
0810	000	0811	000	0812	500	0813	000	0814	000	0815	000	3021
0816	999	0817	999	0818	000	0819	000	0820	000	0821	000	3022
0901	000	0902	000	0903	000	0904	000	0905	000	0906	000	3023
0907	000	0908	000	1001	999	1002	000	1003	000	1004	999	3024
1005	200	1006	833	1007	999	1008	999	1009	500	1010	000	3025
1011	000	1012	000	1013	000	1014	999	1015	000	1016	000	3026
1017	000	1018	000	1019	000	1101	999	1102	000	1103	999	3027
1104	000	1105	000	1106	000	1107	999	1108	000	1109	000	3028
1110	000	1201	000	1202	999	1203	000	1204	000	1205	000	3029
1206	000	1207	999	1208	000	1209	000	1301	000	1302	999	3030
1303	999	1304	000	1305	000	1401	000	1402	000	1403	000	3031
1404	999	1405	000	1406	000	1407	000	1408	000	1409	000	3032
1410	000	1411	000	1501	000	1502	000	1503	000	1504	999	3033
1505	000	1506	000	1507	000	1508	000	1509	000	1510	000	3034
1511	000	1512	000	1513	000	1514	000	1515	000	1516	000	3035
1517	000	1518	000	1519	000	1520	000	1521	000	1522	000	3036
1601	000	1602	000	1603	000	1701	000	1702	000	1703	000	3037
1801	000	1802	000	1803	000	1901	000	1902	000	1903	000	3038
1904	000	1905	999	1906	999	2001	000	2002	000	2003	999	3039
2101	000	2201	500	2202	000	2203	000	2301	000	2401	999	3040
2501	000											3041

32	FUNCTION	P22,D241	PROB NOR/MA	NO ABORT	IN-FLIGHT		
0101	9999990102	5000000103	4285710104	0000000105	0000000106	285714	3201
0107	2000000108	0000000109	5000000110	6666670111	5000000112	285714	3202
0113	0000000114	7500000115	6250000116	5000000201	4000000202	428571	3203
0203	0909090204	9999990205	0000000301	2500000302	7500000303	500000	3204
0304	0000000305	0000000401	6666670402	9999990403	0000000404	666667	3205
0405	5483870406	8571430407	0000000408	9999990409	5000000410	625000	3206
0411	9999990412	9999990413	0000000414	0000000415	8571430416	333333	3207
0417	8000000418	7368420419	7500000420	6666670421	0000000422	666667	3208
0423	0000000424	9999990425	6666670501	2000000502	4444440503	999999	3209
0504	9999990505	0000000506	6666670507	9999990508	0000000509	000000	A3210
0510	4545450511	0000000512	9999990513	9999990514	9999990515	000000	3211
0516	6666670517	1250000601	5555560602	8000000603	0000000604	000000	3212
0605	3333330606	6000000607	4666670608	6666670609	7000000610	533333	3213
0611	1666670612	5000000613	4117650614	5625000615	8000000616	785714	3214
0617	0000000618	6666670701	9999990702	6666670703	2000000704	333333	3215
0705	0000000706	0000000707	0000000708	2857140709	3333330710	999999	3216
0711	0000000712	2000000713	2500000714	2000000715	0000000716	833333	3217
0717	0000000718	9999990719	0000000720	9999990721	6666670722	000000	3218
0723	9999990724	6666670725	0000000801	0000000802	7142860803	250000	3219
0804	9999990805	5000000806	9999990807	0000000808	9999990809	000000	3220
0810	6666670811	4146340812	3877550813	4444440814	2500000815	000000	3221
0816	5000000817	0000000818	9999990819	0000000820	0000000821	000000	3222

0901	5000000902	1428570903	0000000904	0000000905	0000000906	000000	3223
0907	0000000908	0000001001	3157891002	5000001003	5000001004	560000	3224
1005	5555561006	5243901007	8421051008	3870971009	6153851010	444444	3225
1011	6666671012	0000001013	0000001014	0000001015	9999991016	333333	3226
1017	6666671018	0000001019	6666671101	2500001102	4545451103	333333	3227
1104	2916671105	3103451106	3333331107	2000001108	3333331109	266667	3228
1110	0000001201	9999991202	9999991203	0000001204	0000001205	800000	3229
1206	6000001207	5000001208	3333331209	0000001301	6000001302	000000	3230
1303	4545451304	7500001305	9999991401	5000001402	0000001403	000000	3231
1404	2000001405	6000001406	0000001407	3333331408	0000001409	000000	3232
1410	0000001411	0000001501	2916671502	1428571503	3000001504	300000	3233
1505	4285711506	0000001507	5000001508	5000001509	3333331510	416667	3234
1511	5333331512	3750001513	7500001514	6000001515	6666671516	285714	3235
1517	9999991518	4285711519	9999991520	2000001521	8000001522	333333	3236
1601	0000001602	6666671603	0000001701	8000001702	6666671703	000000	3237
1801	5000001802	4285711803	8333331901	0000001902	5000001903	428571	3238
1904	4000001905	6086961906	5555562001	1111112002	1111112003	274194	3239
2101	3809522201	5454552202	5000002203	2500002301	3478262401	000000	3240
2501	000000						3241
33	FUNCTION	P22,D?41	PROB NOR/MA	NO ABORT	AIRCREW		
0101	9999990102	0000000103	5000000104	9999990105	0000000106	500000	3301
0107	8000000108	9999990109	5000000110	9999990111	2500000112	000000	3302
0113	9999990114	5000000115	0000000116	9999990201	0000000202	000000	3303
0203	0000000204	0000000205	0000000301	0000000302	9999990303	000000	3304
0304	9999990305	0000000401	0000000402	0000000403	0000000404	000000	3305
0405	0000000406	0000000407	0000000408	0000000409	0000000410	000000	3306
0411	9999990412	0000000413	0000000414	0000000415	9999990416	000000	3307
0417	0000000418	0000000419	0000000420	0000000421	9999990422	000000	3308
0423	0000000424	0000000425	0000000501	7500000502	9999990501	000000	3309
0504	0000000505	0000000506	9999990507	6666670508	0000000509	000000	A3310
0510	6000000511	0000000512	0000000513	7000000514	0000000515	000000	3311
0516	0000000517	0000000601	0000000602	0000000603	0000000604	000000	3312
0605	6666670606	3333330607	7142860608	9999990609	0000000610	000000	3313
0611	6666670612	9999990613	2222220614	9999990615	0000000616	000000	3314
0617	0000000618	0000000701	5000000702	0000000703	9999990704	999999	3315
0705	0000000706	0000000707	0000000708	6666670709	0000000710	000000	3316
0711	0000000712	9999990713	0000000714	0000000715	9999990716	999999	3317
0717	0000000718	9999990719	0000000720	0000000721	0000000722	000000	3318
0723	0000000724	9999990725	0000000801	0000000802	0000000803	666667	3319
0804	0000000805	0000000806	9999990807	0000000808	5000000809	000000	3320
0810	0000000811	0000000812	0000000813	0000000814	0000000815	000000	3321
0816	0000000817	0000000818	6666670819	0000000820	0000000821	000000	3322
0901	9999990902	0000000903	0000000904	9999990905	0000000906	000000	3323
0907	0000000908	0000001001	0000001002	9999991003	0000001004	000000	3324
1005	5000001006	0000001007	0000001008	0000001009	0000001010	000000	3325
1011	0000001012	0000001013	0000001014	0000001015	0000001016	000000	3326
1017	0000001018	0000001019	0000001101	0000001102	0000001103	000000	3327
1104	0000001105	0000001106	0000001107	0000001108	0000001109	333333	3328
1110	0000001201	0000001202	0000001203	0000001204	0000001205	000000	3329
1206	0000001207	0000001208	0000001209	0000001301	0000001302	000000	3330
1303	0000001304	0000001305	0000001401	0000001402	0000001403	000000	3331
1404	0000001405	0000001406	0000001407	0000001408	0000001409	000000	3332
1410	0000001411	0000001501	9999991502	0000001503	0000001504	000000	3333

1505	0000001506	0000001507	0000001508	0000001509	0000001510	000000	3334
1511	0000001512	0000001513	0000001514	0000001515	0000001516	000000	3335
1517	0000001518	0000001519	0000001520	0000001521	0000001522	000000	3336
1601	0000001602	0000001603	0000001701	0000001702	0000001703	000000	3337
1801	0000001802	0000001803	0000001901	0000001902	0000001903	000000	3338
1904	0000001905	0000001906	0000002001	0000002002	0000002003	000000	3339
2101	0000002201	9999992202	0000002203	0000002301	0000002401	000000	3340
2501	000000						3341
34	FUNCTION	P22.D241	PROB NOR/MA	PREFLIGHT			
0101	7692310102	6666670103	7916670104	5000000105	7058820106	529412	3401
0107	9999990108	6666670109	4500000110	0000000111	6470590112	764706	3402
0113	6923080114	7272730115	6153850116	6585370201	5000000202	666667	3403
0203	4545450204	2857140205	9999990301	7368420302	9999990303	666667	3404
0304	6000000305	7500000401	0000000402	0000000403	0000000404	000000	3405
0405	5000000406	9999990407	7500000408	0000000409	0000000410	999999	3406
0411	8571430412	2857140413	7500000414	9999990415	8333330416	000000	3407
0417	9999990418	6363640419	5000000420	0000000421	8000000422	999999	3408
0423	5000000424	0000000425	9999990501	7307690502	9999990503	833333	3409
0504	9999990505	6666670506	6666670507	7777780508	9999990509	999999	A3410
0510	6129030511	9999990512	0000000513	6666670514	9999990515	999999	3411
0516	6153850517	9999990601	6666670602	9999990603	0000000604	800000	3412
0605	8571430606	0000000607	5000000608	8750000609	4000000610	666667	3413
0611	5000000612	8888890613	7272730614	5000000615	9999990616	714286	3414
0617	8000000618	6666670701	9999990702	5000000703	6250000704	750000	3415
0705	3333330706	0000000707	0000000708	6666670709	0000000710	666667	3416
0711	0000000712	5000000713	0000000714	0000000715	5000000716	000000	3417
0717	9999990718	4000000719	3333330720	6000000721	5000000722	000000	3418
0723	9999990724	8333330725	0000000801	5000000802	4285710803	444444	3419
0804	9999990805	7500000806	8750000807	7500000808	5000000809	000000	3420
0810	0000000811	6666670812	5714290813	3333330814	0000000815	000000	3421
0816	9999990817	9999990818	6000000819	9999990820	9999990821	000000	3422
0901	9999990902	5000000903	7142860904	0000000905	0000000906	500000	3423
0907	0000000908	0000001001	9999991002	7500001003	7142861004	750000	3424
1005	9909091006	8888891007	5555561008	0000001009	9999991010	999999	3425
1011	0000001012	0000001013	6666671014	0000001015	9999991016	000000	3426
1017	9999991018	0000001019	6666671101	3333331102	0000001103	999999	3427
1104	0000001105	9999991106	9999991107	6000001108	7500001109	500000	3428
1110	0000001201	9999991202	6666671203	9999991204	9999991205	833333	3429
1206	6250001207	5000001208	9999991209	9999991301	0000001302	999999	3430
1303	7500001304	0000001305	0000001401	9999991402	3333331403	000000	3431
1404	6666671405	9999991406	9999991407	7500001408	9999991409	000000	3432
1410	0000001411	0000001501	9999991502	5000001503	5000001504	666667	3433
1505	0000001506	0000001507	5000001508	0000001509	9999991510	999999	3434
1511	5000001512	0000001513	0000001514	0000001515	7500001516	999999	3435
1517	0000001518	9999991519	0000001520	5000001521	0000001522	000000	3436
1601	9999991602	0000001603	0000001701	6666671702	0000001703	250000	3437
1801	5000001802	0000001803	0000001901	0000001902	9999991903	000000	3438
1904	0000001905	9999991906	7142862001	5000002002	0000002003	437500	3439
2101	5000002201	8333332202	3333332203	0000002301	0000002401	000000	3440
2501	000000						3441
35	FUNCTION	P22.D241	PROB NOR/MA	DAILY			
0101	8000000102	6666670103	8181820104	7500000105	6666670106	454545	3501
0107	0000000108	9999990109	7777780110	9999990111	6000000112	882353	3502

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0113  8461540114  7142860115  5714290116  7500000201  6666670202  999999   3503
0203  5000000204  5000000205  0000000301  7333330302  9999990303  999999   3504
0304  9999990305  9999990401  0000000402  0000000403  0000000404  000000   3505
0405  5000000406  0000000407  0000000408  9999990409  0000000410  000000   3506
0411  9999990412  3333330413  9999990414  9999990415  9999990416  000000   3507
0417  0000000418  8000000419  9999990420  0000000421  0000000422  999999   3508
0423  0000000424  0000000425  9999990501  5000000502  9999990503  999999   3509
0504  0000000505  9999990506  8571430507  9999990508  9999990509  000000   A3510
0510  7142860511  9999990512  0000000513  0000000514  0000000515  999999   3511
0516  6666670517  0000000601  9999990602  9999990603  0000000604  666667   3512
0605  5000000606  2500000607  5000000608  7500000609  5000000610  000000   3513
0611  9999990612  7500000613  8888890614  0000000615  0000000616  333333   3514
0617  5000000618  9999990701  9999990702  0000000703  5000000704  999999   3515
0705  9999990706  0000000707  0000000708  5000000709  0000000710  000000   3516
0711  0000000712  9999990713  0000000714  0000000715  9999990716  000000   3517
0717  9999990718  5000000719  0000000720  2500000721  3333330722  000000   3518
0723  0000000724  9999990725  9999990801  0000000802  7142860803  333333   3519
0804  0000000805  6000000806  9999990807  9999990808  9999990809  000000   3520
0810  0000000811  9999990812  5000000813  9999990814  0000000815  000000   3521
0816  9999990817  5000000818  4000000819  9999990820  0000000821  000000   3522
0901  9999990902  9999990903  3000000904  0000000905  0000000906  000000   3523
0907  0000000908  0000001001  0000001002  0000001003  9999991004  000000   3524
1005  6250001006  0000001007  0000001008  0000001009  5000001010  000000   3525
1011  0000001012  0000001013  9999991014  0000001015  9999991016  000000   3526
1017  0000001018  0000001019  5000001101  0000001102  0000001103  000000   3527
1104  0000001105  0000001106  0000001107  5000001108  9999991109  000000   3528
1110  0000001201  5000001202  6666671203  9999991204  9999991205  000000   3529
1206  5000001207  9999991208  0000001209  9999991301  0000001302  666667   3530
1303  3333331304  0000001305  0000001401  0000001402  9999991403  000000   3531
1404  0000001405  0000001406  0000001407  0000001408  0000001409  000000   3532
1410  0000001411  0000001501  0000001502  0000001503  0000001504  000000   3533
1505  0000001506  0000001507  0000001508  0000001509  0000001510  000000   3534
1511  0000001512  0000001513  0000001514  0000001515  0000001516  000000   3535
1517  0000001518  9999991519  0000001520  0000001521  0000001522  000000   3536
1601  9999991602  0000001603  0000001701  9999991702  0000001703  999999   3537
1801  0000001802  0000001803  0000001901  0000001902  0000001903  000000   3538
1904  0000001905  0000001906  0000002001  0000002002  0000002003  999999   3539
2101  9999992201  0000002202  0000002203  0000002301  0000002401  000000   3540
2501  000000                                                               3541
 37    FUNCTION    FN46,L241   PERCENT REM AND RPL, PERCENT GS RPR/RC'D
0101  1000000102  0000000103  1500000104  0000000105  1500000106  950000   3701
0107  0500000108  0000000109  2500000110  0000000111  0500000112  150000   3702
0113  1500000114  5009990115  1500000116  1500000201  9500000202  950000   3703
0203  0500000204  0500000205  0500000301  6000000302  9990000303  000000   3704
0304  0000000305  0000000401  9009990402  9000000403  1009990404  950999   3705
0405  9508980406  9009990407  9999990408  5001400409  0500000410  950947   3706
0411  9509990412  0500000413  0000000414  9507250415  0000000416  000000   3707
0417  1300000418  0400000419  7000000420  9999990421  9999990422  000000   3708
0423  0000000424  0000000425  0000000501  9500000502  1500000503  950000   3709
0504  8310070505  9509990506  9500000507  9507050508  9509990509  950999   C3710
0510  0500000511  9509990512  9500000513  9509990514  0500000515  050000   3711
0516  0000000517  0000000601  9509600602  7009990603  7009990604  100000   3712
0605  7509070606  7509990607  7509730608  1500000609  1600000610  250160   3713
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0611	0000000612	0000000613	0200000614	3003000615	8004630616	000000	3714
0617	2509990618	4005320701	9999990702	0000000703	1100000704	000000	3715
0705	9509990706	9990000707	9990000708	2009990709	0000000710	950000	3716
0711	9509990712	2009990713	0000000714	0000000715	2009990716	400125	3717
0717	9500000718	9500000719	9009990720	9009030721	9009350722	600000	3718
0723	0000000724	1000000725	5009990801	9009990802	9000000803	900000	3719
0804	9000000805	9000000806	9000000807	9000000808	9000000809	000000	3720
0810	1000000811	1000000812	1000000813	4009990814	4006380815	999000	3721
0816	9990000817	9990000818	0000000819	9009990820	9990000821	500999	3722
0901	1400000902	0500000903	0500000904	4000000905	9000000906	050000	3723
0907	0500000908	0500001001	9506111002	9009441003	9009001004	950916	3724
1005	5009801006	9000001007	9990001008	9990001009	0500001010	000000	3725
1011	0000001012	0000001013	0000001014	0000001015	0000001016	000000	3726
1017	1500001018	0000001019	0000001101	0700001102	0000001103	800063	3727
1104	8000001105	1000001106	9000001107	9000001108	0500001109	250000	3728
1110	000000.201	4001751202	0000001203	3000001204	0000001205	500240	3729
1206	0000001207	8000001208	5001401209	8000001301	9508791302	000000	3730
1303	9507811304	0000001305	0000001401	0000001402	3300001403	900000	3731
1404	1000001405	9000001406	9000001407	9000001408	9000001409	900000	3732
1410	000000[411	0[00001501	9001741502	9001561503	9001281504	900276	3733
1505	9002861506	[000001507	9004751[0[	9003541509	9002761510	900747	3734
1511	9003181512	9003801513	9003291[51	9004751515	9002081516	900296	3735
1517	9003071518	9004571519	9009991520	9009991521	8000001522	900354	3736
1601	9009991[0[	9000471603	9003261701	2009991702	3000911703	400999	3737
1801	600791180[	4004041803	4001941901	4009991902	4009991903	400099	3738
1904	4009991905	4008181906	4007782001	1500712002	1509992003	100999	3739
2101	6007652201	6009672202	6009992203	6001542301	2006002401	000000	3740
2501	250000						3741

40	FUNCTION	FN46,L241	SKILL CODE-WORK CENTER				
0101	0601030102	0003010103	0601030104	0001030105	0601030106	060103	4001
0107	0601030108	0001030109	0601030110	0001030111	0601030112	060103	4002
0113	0601030114	0601030115	0601030116	0601030201	0603010202	060103	4003
0203	0603010204	0603010205	0603010301	0601030302	0601030303	000103	4004
0304	0001030305	0000030401	0603010402	0600010403	0603010404	060301	4005
0405	0103010406	0603020407	0600030408	0600010409	0403010410	040103	4006
0411	0603010412	0603010413	0000010414	0401030415	0003010416	000301	4007
0417	0303010418	0301030419	0303010420	0301030421	0603010422	000103	4008
0423	0003010424	0000030425	0001030501	0101030502	0603010503	060001	4009
0504	0603010505	0103010506	0303010507	0603010508	0603010509	060301	A4010
0510	0303010511	0103010512	0100010513	0103010514	0103010515	010103	4011
0516	0101030517	0003010601	0103010602	0103010603	0103010604	060301	4012
0605	0103010606	0103010607	0103010608	0103010609	0100010610	010301	4013
0611	0003010612	0003010613	0103010614	0401030615	0401030616	060301	4014
0617	0401030618	0103010701	0103010702	0001030703	0603010704	000301	4015
0705	0603010706	0003010707	0600030708	0103010709	0001030710	040301	4016
0711	0000010712	0103010713	0001030714	0001030715	0103010716	010301	4017
0717	0603010718	0603010719	0103010720	0103010721	0103010722	060001	4018
0723	0000010724	0103010725	0103010801	0603010802	0601030803	060103	4019
0804	0603010805	060[030806	0600030807	0600030808	0601030809	000003	4020
0810	0403010811	0403010812	0603010813	0403010814	0401030815	010301	4021
0816	0103010817	0100010818	0003010819	0100010820	0100010821	010301	4022
0901	0403010902	0401030903	0600010904	0401030905	0400030906	060301	4023
0907	0403010908	0600031001	0402031002	0401031003	0401031004	040103	4024

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1305 0401031006 0401031007 0401031008 0400031009 0401031010 000103  4025
1011 0000031012 0000031013 0000031014 0000031015 0000031016 000201  4026
1017 0401031018 0000011019 0001031101 0400031102 0401031103 040103  4027
1104 0401031105 0401031106 0401031107 0401031108 0401031109 040103  4028
1110 0303011201 0300031202 0001031203 0003011204 0000031205 030103  4029
1206 0301031207 0301031208 0301031209 0303011301 0603011302 000301  4030
1303 0403011304 0000031305 0003011401 0601031402 0601031403 040003  4031
1404 0601031405 0603011406 0603011407 0401031408 0603011409 040003  4032
1410 0000031411 0000031501 0401031502 0401031503 0401031504 040103  4033
1505 0402031506 0000031507 0401031508 0400031509 0502031510 040103  4034
1511 0401031512 0601031513 0401031514 0401031515 0401031516 040003  4035
1517 0400031518 0401031519 0400031520 0400031521 0601031522 040203  4036
1601 0400031602 0400031603 0403011701 0501021702 0500021703 050302  4037
1801 0503021802 0500021803 0503021901 0500021902 0503021903 050002  4038
1904 0500021905 0503021906 0501022001 0603022002 0501022003 050102  4039
2101 0503022201 0501022202 0501022203 0503022301 0501022401 000103  4040
2501 060103                                                         4041
 42   FUNCTION   FN46,L241   MPR OFF-FOMT RPR,MPR REP 20WC,MPR RER 10WC
0101 1101103102 0000000103 1305080104 1105060105 1303100106 140311  4201
0107 1001100108 0005050109 2002080110 0000000111 1302080112 110208  4202
0113 1306070114 1406190115 1204005116 1301120201 1604060202 100406  4203
0203 1105053204 1105053205 1005050301 1703200302 2906230303 000000  4204
0304 0000000305 0000000401 1404220402 1000100403 2010100404 280919  4205
0405 1710173406 3503030407 1500130408 9900200409 1004170410 100120  4206
0411 1201090412 1304070413 0000000414 1009180415 0004060416 000000  4207
0417 0004060418 0007090419 1027270420 1308110421 1607090422 000000  4208
0423 0009090424 0000200425 0000000501 1007080502 1303070503 120010  4209
0504 1009110505 1210100506 1003140507 1604210508 1001070509 100505  A4210
0510 1019210511 3003070512 1000100513 1702080514 1004060515 110308  4211
0516 3400000517 0000000601 2412220602 1110100603 1010100604 100307  4212
0605 1511190606 1812510607 1405350608 2401170609 0000340610 180117  4213
0611 0001090612 0001090613 0004160614 1004200615 1001100616 100708  4214
0617 1402080618 1103210701 1605180702 0000000703 1005240704 000000  4215
0705 1204080706 0010100707 0000000708 1404100709 0008120710 101725  4216
0711 0000000712 2208140713 0000000714 0000000715 2007130716 100413  4217
0717 1304060718 1302080719 1601110720 1202180721 9905150722 100010  4218
0723 0000000724 1704060725 1002080801 1005050802 1204080803 170515  4219
0804 2208210805 1102170806 1800120807 1700100808 1503120809 000000  4220
0810 1302110811 1002120812 1603050813 1201110814 1003180815 200810  4221
0816 2009120817 1800210818 0000000819 1400140820 1800180821 100307  4222
0901 1003070902 3403120903 1101110904 1003110905 1000100906 331121  4223
0907 1005050908 1000101001 1001211002 1502131003 1001151004 100113  4224
1005 1805151006 1301221007 1401171008 1000361009 1002161010 000000  4225
1011 0000301012 0000001013 0000001014 0000001015 0000001016 001010  4226
1017 1002151018 0000001019 0000001101 1100151102 1006131103 140113  4227
1104 1902171105 1303201106 1001111107 1003141108 1203071109 100418  4228
1110 0000001201 1200281202 0000001203 0000001204 0000001205 100121  4229
1206 0000001207 100415.208 1006131209 1400311301 1905091302 000000  4230
1303 1009091304 0000001305 0000001401 1001091402 0003071403 170020  4231
1404 1405151405 2603071406 1305091407 1006091408 1010101409 100010  4232
1410 0000001411 0000001501 1202111502 1003111503 1001161504 110211  4233
1505 1001151506 0000001507 1001171508 1000101509 1003131510 100113  4234
1511 1001101512 1902081513 1004161514 1002201515 1003151516 100014  4235
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1517  1000131518  1001141519  1800181520  1300131521  2204181522  100307    4236
1601  1700171602  1000121603  1005081701  2205151702  1000151703  100810    4237
1801  1001151802  1000161803  1002221901  1000101902  1002111903  160015    4238
1904  1200141905  1001151906  1001122001  1801112002  1001092003  100215    4239
2101  1204132201  1501152202  1502182203  1004142301  1804142401  000000    4240
2501  100307                                                               4241
 43    FUNCTION    FN46.L241   OFF-EQUIP RPR MEMT, ORGAN REM AND RPL MEMT
0101  0050050102  0000000103  0090090104  0150150105  0090090106  000900  4301
0107  0140220108  0000200109  1600100110  0000000111  0090080112  008008  4302
0113  0090090114  0860020115  0100100116  0190190201  0090200202  000300  4303
0203  0070050204  0110400205  0090050301  0070080302  0420230303  000000  4304
0304  0300000305  0300000401  0061400402  0050200403  0050050404  017017  4305
0405  0080590406  0120580407  0130080408  0050070409  0100750410  011026  4306
0411  0500100412  0110100413  0000000414  0050570415  0000100416  000000  4307
0417  0300300418  0000340419  0041010420  0060250421  0160160422  000000  4308
0423  0300600424  0000500425  0000000501  0070160502  0100100503  007010  4309
0504  0160370505  0080330506  0100200507  0030380508  0040130509  004012  C4310
0510  0030440511  0200260512  0130100513  0110150514  0070100515  005005  4311
0516  0130000517  0000000601  0501900602  0090800603  0070800604  010080  4312
0605  0192550606  0133800607  0142300608  0160690609  0000650610  011023  4313
0611  0000100612  0000100613  0000270614  0050190615  0050210616  005020  4314
0617  0060170618  0219670701  0230270702  0000000703  0012250704  000000  4315
0705  0070600706  0000500707  0001540708  0110110709  0000050710  030053  4316
0711  0000000712  0130130713  0000000714  0000000715  0500250716  002074  4317
0717  0070100718  0070130719  0190180720  0070180721  0180150722  005005  4318
0723  0000000724  0120130725  0220270801  0130100802  0180180803  030028  4319
0804  0690200805  0100090806  0240450807  0340240808  0190190809  000000  4320
0810  0080080811  0060110812  0090210813  0070070814  0100100815  018050  4321
0816  0020330817  0250230818  0000000819  0040040820  0170170821  005000  4322
0901  0040050902  0130090903  0060060904  0050130905  0050050906  029029  4323
0907  0040040908  0800801001  0090371002  0240101003  0450141004  013014  4324
1005  0620101006  0120141007  0190191008  0110101009  0050141010  000000  4325
1011  0000201012  0000001013  0000001014  0000001015  0000001016  000005  4326
1017  0230131018  0000001019  0000301101  0450061102  0150141103  030009  4327
1104  0080081105  0100201106  0080131107  0100141108  0080051109  006016  4328
1110  0000001201  0060161202  0000001203  0000001204  0000001205  001040  4329
1206  0000001207  0180171208  0050171209  0120121301  0100551302  000000  4330
1303  0130341304  0000001305  0000001401  0030351402  0000301403  005020  4331
1404  0060101405  0200051406  0070071407  0050101408  0050401409  010010  4332
1410  0000001411  0000001501  0070131502  0040091503  0080081504  007009  4333
1505  0070091506  0000001507  0110071508  0090131509  0060081510  020015  4334
1511  0060091512  0100191513  0080111514  0060151515  0060121516  005017  4335
1517  0070111518  0040111519  0130131520  0150151521  0670671522  005010  4336
1601  0080081602  0080111603  0060101701  0450611702  0400921703  030085  4337
1801  0350111802  0050151803  0060191901  0070071902  0650161903  145023  4338
1904  0080131905  0360091906  0280112001  0240142002  0050052003  023010  4339
2101  0160.42201  0290112202  0190142203  0050092301  0300162401  000000  4340
2501  013015                                                               4341
 46    FUNCTION    P22.D241    ELEMENTS TABLE CODE
0101  1    0102   2    0103   3    0104   4    0105   5    0106   6       4601
0107  7    0108   8    0109   9    0110   10   0111   11   0112   12      4602
0113  13   0114   14   0115   15   0116   16   0201   17   0202   18      4603
0203  19   0204   20   0205   21   0301   22   0302   23   0303   24      4604
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0304	25	0305	26	0401	27	0402	28	0403	29	0404	30	4605
0405	31	0406	32	0407	33	0408	34	0409	35	0410	36	4606
0411	37	0412	38	0413	39	0414	40	0415	41	0416	42	4607
0417	43	0418	44	0419	45	0420	46	0421	47	0422	48	4608
0423	49	0424	50	0425	51	0501	52	0502	53	0503	54	4609
0504	55	0505	56	0506	57	0507	58	0508	59	0509	60	4610
0510	61	0511	62	0512	63	0513	64	0514	65	0515	66	4611
0516	67	0517	68	0601	69	0602	70	0603	71	0604	72	4612
0605	73	0606	74	0607	75	0608	76	0609	77	0610	78	4613
0611	79	0612	80	0613	81	0614	82	0615	83	0616	84	4614
0617	85	0618	86	0701	87	0702	88	0703	89	0704	90	4615
0705	91	0706	92	0707	93	0708	94	0709	95	0710	96	4616
0711	97	0712	98	0713	99	0714	100	0715	101	0716	102	4617
0717	103	0718	104	0719	105	0720	106	0721	107	0722	108	4618
0723	109	0724	110	0725	111	0801	112	0802	113	0803	114	4619
0804	115	0805	116	0806	117	0807	118	0808	119	0809	120	4620
0810	121	0811	122	0812	123	0813	124	0814	125	0815	126	4621
0816	127	0817	128	0818	129	0819	130	0820	131	0821	132	4622
0901	133	0902	134	0903	135	0904	136	0905	137	0906	138	4623
0907	139	0908	140	1001	141	1002	142	1003	143	1004	144	4624
1005	145	1006	146	1007	147	1008	148	1009	149	1010	150	4625
1011	151	1012	152	1013	153	1014	154	1015	155	1016	156	4626
1017	157	1018	158	1019	159	1101	160	1102	161	1103	162	4627
1104	163	1105	164	1106	165	1107	166	1108	167	1109	168	4628
1110	169	1201	170	1202	171	1203	172	1204	173	1205	174	4629
1206	175	1207	176	1208	177	1209	178	1301	179	1302	180	4630
1303	181	1304	182	1305	183	1401	184	1402	185	1403	186	4631
1404	187	1405	188	1406	189	1407	190	1408	191	1409	192	4632
1410	193	1411	194	1501	195	1502	196	1503	197	1504	198	4633
1505	199	1506	200	1507	201	1508	202	1509	203	1510	204	4634
1511	205	1512	206	1513	207	1514	208	1515	209	1516	210	4635
1517	211	1518	212	1519	213	1520	214	1521	215	1522	216	4636
1601	217	1602	218	1603	219	1701	220	1702	221	1703	222	4637
1801	223	1802	224	1803	225	1901	226	1902	227	1903	228	4638
1904	229	1905	230	1906	231	2001	232	2002	233	2003	234	4639
2101	235	2201	236	2202	237	2203	238	2301	239	2401	240	4640
2501	241											4641

47	FUNCTION	FN46,L241	PERCENT NRTS (1-8),		PERCENT NRTS (1-9)		
0101	0000000102	0000000103	0000000104	0000000105	0000000106	000000	4701
0107	0000000108	0000000109	0000000110	0000000111	0000000112	000000	4702
0113	0000000114	0000000115	0000000116	0000000201	0000000202	999999	4703
0203	0000000204	0000000205	0000000301	0000000302	9999990303	000000	4704
0304	0000000305	0000000401	0000000402	6676670403	0000000404	000000	4705
0405	5005000406	0000000407	0000000408	9999990409	0000000410	000143	4706
0411	0000000412	0000000413	0000000414	5005000415	0000000416	000000	4707
0417	9999990418	9999990419	9999990420	0000000421	9999990422	000000	4708
0423	0000000424	0000000425	0000000501	5005000502	0000000503	000000	4709
0504	1698310505	9999990506	7507500507	8008000508	0000000509	000000	04710
0510	9999990511	0000000512	0000000513	0000000514	9999990515	000000	4711
0516	2502500517	0000000601	2502500602	0000000603	0000000604	000000	4712
0605	9999990606	0000000607	9999990608	9999990609	9999990610	999999	4713
0611	0000000612	0000000613	9999990614	9009000615	9009990616	000000	4714
0617	0000000618	9999990701	0000000702	0000000703	9999990704	000000	4715

0705	0000000706	0000000707	9999990708	9999990709	0000000710	999999	4716
0711	0000000712	0000000713	0000000714	0000000715	0000000716	999999	4717
0717	0000000718	0000000719	0000000720	9999990721	4004000722	000000	4718
0723	0000000724	0000000725	0000000801	0000000802	0000000803	000000	4719
0804	0000000805	0000000806	0000000807	0000000808	0000000809	000000	4720
0810	0000000811	9999990812	0000000813	0000000814	9999990815	999999	4721
0816	8858850817	0000000818	0000000819	0000000820	0000000821	000000	4722
0901	0009990902	0000000903	0000000904	9999990905	0000000906	000000	4723
0907	0000000908	0000001001	9999991002	2502501003	7507501004	400400	4724
1005	0320321006	4506501007	9389991008	5715711009	0000001010	000000	4725
1011	0000001012	0000001013	0000001014	0000001015	0000001016	000000	4726
1017	5005001018	0000001019	0000001101	1671671102	0000001103	667667	4727
1104	0000001105	0000001106	9999991107	5385381108	0000001109	999999	4728
1110	0000001201	9999991202	0000001203	0000001204	0000001205	999999	4729
1206	0000001207	0000001208	0009991209	0000001301	9999991302	000000	4730
1303	9999991304	0000001305	0000001401	0000001402	9999991403	000000	4731
1404	0000001405	0000001406	0000001407	9999991408	0000001409	000000	4732
1410	0000001411	0000001501	9999991502	9999991503	9999991504	941941	4733
1505	8008001506	0000001507	7507501508	9999991509	7507501510	999999	4734
1511	9999991512	9999991513	9999991514	9999991515	9999991516	999999	4735
1517	9999991518	9999991519	0000001520	0000001521	9999991522	999999	4736
1601	0000001602	9999991603	9999991701	0000001702	9999991703	000000	4737
1801	1671671802	9999991803	9999991901	0000001902	0000001903	000000	4738
1904	0000001905	1201201906	1761762001	9999992002	0000002003	000000	4739
2101	1671672201	0180182202	0000002203	9999992301	2502502401	000000	4740
2501	000333						4741
52	FUNCTION	FN46,L241	PCT ITG DS-0	RPR/REM-RPL,	PCT DS	RPR/RC'D	
0101	9990000102	0000000103	9990000104	0000000105	99900000106	999000	5201
0107	9990000108	0000000109	9990000110	0000000111	9990000112	999000	5202
0113	9990000114	9780000115	9990000116	9990000201	9990000202	874000	5203
0203	9990000204	9990000205	9990000301	9990000302	8200000303	000000	5204
0304	0000000305	0000000401	9509992402	9990000403	4885150404	000000	5205
0405	2944160406	2518320407	8330003408	0000000409	9990000410	000000	5206
0411	0000000412	9990000413	0000000414	0430000415	0000000416	000000	5207
0417	0000000418	0000000419	5000300420	0006000421	0000000422	000000	5208
0423	0000000424	0000000425	0000000501	9160000502	9990000503	999000	5209
0504	1280410505	8003200506	5890000507	0000000508	2001350509	800320	C5210
0510	0000000511	7894990512	9990000513	9009990514	9990000515	999000	5211
0516	0000000517	0000000601	0002190602	3768010603	8258360604	999000	5212
0605	0000000606	0000000607	0000000608	0670000609	0000000610	000000	5213
0611	0000000612	0000000613	0000000614	0000000615	0000000616	000000	5214
0617	6655060618	4562140701	8606920702	0000000703	0000000704	000000	5215
0705	9005000706	9990000707	0000000708	5736630709	0000000710	368000	5216
0711	0000000712	0005560713	0000000714	0000000715	0000000716	000000	5217
0717	9990000718	9990000719	0003320720	0003100721	0003170722	999000	5218
0723	0000000724	9990000725	4431910801	5736630802	9990000803	999000	5219
0804	9990000805	9990000806	9990000807	9990000808	9990000809	000000	5220
0810	9990000811	9990000812	9990000813	3335010814	1010000815	670000	5221
0816	8200000817	9990000818	0000003819	7703360820	9990000821	947000	5222
0901	0000000902	9990000903	9990000904	0000000905	9990000906	999000	5223
0907	9990000908	9990001001	0000001002	0000001003	0000001004	000000	5224
1005	0000001006	9110001007	3300001008	9200001009	9990001010	000000	5225
1011	0000001012	0000001013	0000001014	0000001015	0000001016	000000	5226

1017	0000C01018	0000001019	0000001101	0000001102	0000001103	375360	5227
1104	9990001105	9990001106	8330001107	7220001108	9990001109	280000	5228
1110	0000001201	0000001202	0000001203	0000001204	0000001205	000000	5229
1206	0000001207	9990001208	0000001209	9990001301	0003041302	000000	5230
1303	0002801304	0000001305	0000031401	0000001402	0000001403	999000	5231
1404	9990001405	9990001406	9990001407	7440001408	9990001409	999000	5232
1410	0000001411	0000001501	0003951502	0003681503	0003251504	000509	5233
1505	0005181506	0000001507	0006401508	0005701509	0005091510	000737	5234
1511	0005441512	0005881513	0005531514	0006401515	0004391516	000526	5235
1517	0005351518	0006321519	0007891520	0007891521	9990001522	000570	5236
1601	0007891602	0001491603	0000881701	5000001702	0830001703	500000	5237
1801	4420001802	2870001803	1630001901	5000001902	5000001903	500000	5238
1904	5000001905	4500001906	4370002001	0670002002	5000002003	500000	5239
2101	4330002201	4920002202	5000002203	1330002301	3750002401	000000	5240
2501	600000						5241
53	FUNCTION	FN46,L241	ORGAN MENT	REPAIR ON -EQUIPMENT			
0101	0050000102	0050000103	0090000104	0150000105	0090000106	009000	5301
0107	0140000108	0110000109	0130000110	0140000111	0090000112	008000	5302
0113	0090000114	0140000115	0100000116	0190000201	0090000202	005000	5303
0203	0070000204	0110000205	0090000301	0070000302	0420000303	012000	5304
0304	0130000305	0160000401	0060000402	0280000403	0050000404	017000	5305
0405	0170000406	0120000407	0130000408	0090000409	0150000410	028000	5306
0411	0150000412	0110000413	0140000414	0170000415	0170000416	013000	5307
0417	0160000418	0110000419	0110000420	0060000421	0160000422	013000	5308
0423	0050000424	0050000425	0320000501	0120000502	0100000503	007000	5309
0504	0230000505	0080000506	0120000507	0180000508	0040000509	004000	C5310
0510	0080000511	0120000512	0130000513	0110000514	0070000515	005000	5311
0516	0070000517	0130000601	0130000602	0090000603	0070000604	008000	5312
0605	0190000606	0130000607	0140000608	0160000609	0100000610	011000	5313
0611	0150000612	0080000613	0110000614	0130000615	0630000616	010000	5314
0617	0060000618	0210000701	0230000702	0080000703	0080000704	008000	5315
0705	0070000706	0090000707	0000000708	0110000709	0100000710	030000	5316
0711	0090000712	0130000713	0090000714	0090000715	0060000716	029000	5317
0717	0070000718	0070000719	0100000720	0070000721	0070000722	005000	5318
0723	0170000724	0120000725	0220000801	0100000802	0180000803	015000	5319
0804	0690000805	0130000806	0240000807	0340000808	0190000809	005000	5320
0810	0080000811	0110000812	0090000813	0070000814	0070000815	018000	5321
0816	0180000817	0250000818	0080000819	0040000820	0000000821	005000	5322
0901	0110000902	0130000903	0060000904	0100000905	0050000906	029000	5323
0907	0040000908	0800001001	0110001002	0110001003	0070001004	031000	5324
1005	0090001006	0100001007	0530001008	0120001009	0160001010	015000	5325
1011	0040001012	0050001013	0050001014	1100001015	0180001016	009000	5326
1017	0190001018	0030001019	0150001101	0340001102	0060001103	007000	5327
1104	0080001105	0100001106	0100001107	0130001108	0080001109	008000	5328
1110	0100001201	0060001202	0110001203	0140001204	0250001205	009000	5329
1206	0160001207	0110001208	0050001209	0120001301	0100001302	012000	5330
1303	0140001304	0130001305	0070001401	0100001402	0030001403	005000	5331
1404	0060001405	0200001406	0070001407	0120001408	0050001409	010000	5332
1410	0200001411	0080001501	0100001502	0070001503	0040001504	012000	5333
1505	0080001506	0130001507	0060001508	0070001509	0080001510	010000	5334
1511	0060001512	0100001513	0090001514	0120001515	0160001516	016000	5335
1517	0110001518	0120001519	0000001520	0150001521	0670001522	007000	5336
1601	0080001602	0080001603	0060001701	0160001702	0060001703	012000	5337

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1801  01100018O2  0080018C3  0410001901  0070001902  0060001903  006000    5338
1904  0080001905  0780001906  0150002001  0240002002  0080002003  014000    5339
2101  0100002201  0120002202  0110002203  0180002301  0120002401  005000    5340
2501  015000                                                               5341
 54    FUNCTION    FN46,L241   MPR ON-EQMT RPR 2 OWC,MPR ON-EQ RPR 1 OWC
0101  CC01100102  0001110103  0005080104  0005060105  0003100106  000311    5401
0107  0001090108  0008090109  0002100110  0002170111  0002110112  000209    5402
0113  0006070114  0003110115  0004080116  0001120201  0006100202  000406    5403
0203  0005060204  0005060205  0005050301  0002150302  0006230303  000414    5404
0304  0001090305  0000330401  0002120402  0000160403  0010100404  000919    5405
0405  0008140406  0010250407  0000150408  0000160409  0005220410  000117    5406
0411  0001110412  0005080413  0000120414  0003070415  0005080416  000313    5407
0417  0005080418  0006080419  0006060420  0005080421  C007090422  000617    5408
0423  0005050424  0000100425  0003150501  0009120502  0003100503  000012    5409
0504  0001010505  0006060506  0002090507  0002120508  0003070509  000505    C5410
0510  0006060511  0003070512  0000100513  0003140514  0004060515  000308    5411
0516  0003080517  0006130601  0004080602  0005060603  0000100604  000307    5412
0605  0006090606  0003150607  0002120608  0001230609  0000140610  000117    5413
0611  0002180612  0001100613  0003120614  0003170615  0001230616  000607    5414
0617  0003110618  0001100701  0003130702  0002130703  0002090704  000609    5415
0705  0004080706  0000000707  0000000708  0004100709  C007110710  000508    5416
0711  0000000712  0008140713  0002100714  0005130715  0003070716  000310    5417
0717  0005080718  0003100719  0001090720  0001110721  0003090722  000010    5418
0723  0000180724  0006110725  0002080801  0005050802  0004080803  000309    5419
0804  0006160805  C001100806  0000180807  0000170808  0003120809  000010    5420
0810  0002110811  0002120812  0004120813  0001110814  0002150815  000911    5421
0816  0010140817  0000180818  0003100819  0000140820  0000000821  000307    5422
0901  0003070902  0007310903  0000110904  0002080905  0000100906  001121    5423
0907  0005050908  0000101001  0001191002  0002121003  0001151004  000118    5424
1005  0005151006  0001211007  0002161008  0000231009  0002151010  000507    5425
1011  0000151012  0000201013  0000121014  0000271015  0000191016  000505    5426
1017  0002161018  0000101019  0003121101  0000331102  0004101103  000111    5427
1104  0002171105  0001111106  0002141107  0004171108  0003091109  000312    5428
1110  0005051201  0000121202  0006081203  0014171204  0000141205  000113    5429
1206  0003171207  0005181208  0010201209  0003111301  0006131302  000308    5430
1303  0005051304  0000261305  0003071401  0002171402  0003071403  000017    5431
1404  0004101405  0009171406  0005081407  0007101408  0005051409  000010    5432
1410  0000181411  0000101501  0003161502  0003091503  0001151504  000211    5433
1505  0001181506  0000241507  0001171508  0000171509  0003121510  000119    5434
1511  0001121512  0004141513  0003141514  0002281515  0003171516  000025    5435
1517  0000171518  0001141519  0000001520  0000131521  0004181522  000307    5436
1601  0000171602  0000121603  0000001701  0004131702  0000141703  000709    5437
1801  0001171802  0000131803  0001181901  0000101902  0002081903  000023    5438
1904  0000121905  0001191906  0002202001  0001172002  0001112003  000215    5439
2101  0003122201  0001212202  0002192203  0004142301  0004132401  000613    5440
2501  000409                                                               5441
1     9999992     8901015     97447111    99999916    90293317    034812    10201
21    987612                                                               10202
0     7760731     776073                                                   10301
0     9779491     977949                                                   10501
0.87901     0.99042     0.99983     0.99994                                11001
0.94381     0.99872     0.99993                                            11101
0.95081     0.99932     0.99993                                            11201
```

```
0.12111     0.32452     0.55213     0.74314     0.87145     0.94326     11401
0.97777     0.99218     0.99759     0.999310    0.999911                11402
0.036101    0.049102    0.055603    0.132304    0.170905    0.278206    11701
0.313307    0.386509    0.392509    0.523310    0.585511    0.596512    11702
0.611013    0.625614    0.761915    0.766416    0.773917    0.794518    11703
0.865219    0.905820    0.916321    0.985022    0.996523    0.997024    11704
0.999925                                                                11705
0.022702    0.045503    0.090904    0.227105    0.522606    0.704507    11801
0.840910    0.863612    0.886315    0.977319    0.999920                11802
0.245101    0.270202    0.311003    0.373304    0.493105    0.575706    11901
0.637907    0.729808    0.743809    0.816210    0.845011    0.871912    11902
0.890213    0.896914    0.919215    0.921116    0.930417    0.934119    11903
0.950819    0.967520    0.973121    0.983322    0.984223    0.985124    11904
0.999925                                                                11905
0.299301    0.323902    0.384203    0.433304    0.551105    0.669406    12001
0.740907    0.823608    0.843709    0.883910    0.904011    0.933012    12002
0.955313    0.968714    0.971015    0.973216    0.979917    0.984421    12003
0.988821    0.991122    0.999925                                        12004
0.270501    0.286902    0.330603    0.448104    0.540405    0.603806    12101
0.691307    0.781408    0.789609    0.847010    0.871611    0.893413    12102
0.907113    0.923514    0.937215    0.939916    0.956317    0.964519    12103
0.967220    0.986322    0.989123    0.999925                            12104
0423 000    0424 013    0425 059    0501 056    0502 315    0503 011    12509
0504 112    0505 000    0506 034    0507 022    0508 000    0509 011    12510
0510 247    0511 011    0512 011    0513 011    0514 011    0515 011    12511
0516 034    0517 101    0601 045    0602 030    0603 005    0604 000    12512
0423 000    0424 000    0425 000    0501 000    0502 167    0503 000    12609
0504 666    0505 000    0506 000    0507 000    0508 000    0509 000    12610
0510 000    0511 000    0512 000    0513 000    0514 000    0515 000    12611
0516 000    0517 167    0601 000    0602 077    0603 000    0604 000    12612
0423 030    0424 000    0425 030    0501 203    0502 016    0503 034    12709
0504 048    0505 023    0506 117    0507 070    0508 008    0509 008    12710
0510 242    0511 016    0512 000    0513 023    0514 008    0515 016    12711
0516 101    0517 008    0601 034    0602 034    0603 011    0604 056    12712
0423 000    0424 000    0425 045    0501 190    0502 038    0503 019    12809
0504 014    0505 038    0506 133    0507 076    0508 038    0509 000    12810
0510 266    0511 019    0512 000    0513 019    0514 000    0515 019    12811
0516 114    0517 019    0601 038    0602 019    0603 000    0604 057    12812
0423 000    0424 000    0425 000    0501 152    0502 030    0503 030    12909
0504 000    0505 030    0506 030    0507 152    0508 000    0509 000    12910
0510 273    0511 061    0512 030    0513 000    0514 030    0515 061    12911
0516 091    0517 030    0601 048    0602 048    0603 000    0604 095    12912
0504 7390610505  9509990506  9500000507  9507050508  9509990509  950999  13710
0504 0420370505  0080330506  0100200507  0030380508  0040130509  004012  14310
0504 1773570505  9999990506  7507500507  8008000508  3000000509  000000  14710
0504 4152610505  8003200506  5890000507  0000000508  2001350509  500320  15210
0504 0200000505  0080000506  0120000507  0180000508  0040000509  004000  15310
0504 00 1020505  0006060506  0002090507  0002120508  0003070509  000505  15410
1       9999992     8895725     97447111    99999916    90308117    034684  20201
21      987519                                                              20202
0       7767311     776731                                                  20301
0       9785241     978524                                                  20501
0.87941     0.99052     0.99983     0.99994                                 21001
```

0.94351		0.99872		0.99993										21101
0.95091		0.99932		0.99993										21201
0.12081		0.32382		0.55133		0.74254		0.87105		0.94306				21401
0.97767		0.99218		0.99759		0.999310		0.999911						21402
0.036201		0.049302		0.055803		0.132804		0.174205		0.275806				21701
0.311007		0.384404		0.390409		0.521710		0.584111		0.595112				21702
0.609713		0.624314		0.761115		0.765616		0.773217		0.793818				21703
0.864719		0.905420		0.916021		0.984922		0.996523		0.997024				21704
0.999925														21705
0.023402		0.046303		0.093704		0.203705		0.508206		0.695607				21801
0.836110		0.859512		0.882915		0.976619		0.999920						21802
0.243601		0.268502		0.309203		0.371004		0.496105		0.578306				21901
0.640107		0.731508		0.745309		0.817310		0.845911		0.872612				21902
0.881013		0.897614		0.919715		0.921616		0.930817		0.934518				21903
0.951119		0.967720		0.973221		0.983422		0.984323		0.985224				21904
0.999925														21905
0.299501		0.324402		0.384803		0.434004		0.550305		0.668906				22001
0.740507		0.823308		0.843409		0.883710		0.903811		0.932912				22002
0.955313		0.968714		0.970915		0.973216		0.979917		0.984320				22003
0.988821		0.991122		0.999925										22004
0.270201		0.286602		0.330203		0.447604		0.540905		0.604306				22101
0.691607		0.781708		0.789809		0.847210		0.871711		0.893612				22102
0.907213		0.923614		0.937215		0.940016		0.956317		0.964519				22103
0.967220		0.986422		0.989123		0.999925								22104
0423	000	0424	013	0425	059	0501	061	0502	340	0503	012			22509
0504	040	0505	000	0506	036	0507	024	0508	000	0509	012			22510
0510	267	0511	012	0512	012	0513	012	0514	012	0515	012			22511
0516	036	0517	109	0601	045	0602	030	0603	005	0604	000			22512
0423	000	0424	000	0425	000	0501	000	0502	213	0503	000			22609
0504	574	0505	000	0506	000	0507	000	0508	000	0509	000			22610
0510	000	0511	000	0512	000	0513	000	0514	000	0515	000			22611
0516	000	0517	213	0601	000	0602	077	0603	000	0604	000			22612
0423	030	0424	000	0425	030	0501	193	0502	015	0503	089			22709
0504	094	0505	022	0506	111	0507	067	0508	007	0509	007			22710
0510	230	0511	015	0512	000	0513	022	0514	007	0515	015			22711
0516	097	0517	007	0601	034	0602	034	0603	011	0604	056			22712
0423	000	0424	000	0425	045	0501	192	0502	038	0503	019			22809
0504	000	0505	038	0506	135	0507	077	0508	038	0509	000			22810
0510	269	0511	019	0512	000	0513	019	0514	000	0515	019			22811
0516	115	0517	019	0601	038	0602	019	0603	000	0604	057			22812
0423	000	0424	000	0425	000	0501	150	0502	030	0503	030			22909
0504	012	0505	030	0506	030	0507	150	0508	000	0509	000			22910
0510	269	0511	060	0512	030	0513	000	0514	030	0515	060			22911
0516	090	0517	030	0601	048	0602	048	0603	000	0604	095			22912
0504	8410760505		9509990506		9500030507		9507050508		9509990509		950999			23710
0504	0400370505		0080330506		0100200507		0030340508		0040130509		004012			24310
0504	1033100505		9999990506		7507500507		8008000508		0000000509		000000			24710
0504	5203000505		8003200506		5890000507		0000000508		2001350509		800320			25210
0504	0290000505		0080000506		0120000507		0160000508		0040000509		004000			25310
0504	0001020505		0006060506		0002090507		0002120508		0003070509		000505			25410
1	9999992		8895405		97447111		99999916		90274117		034812			30201
21	987619													30202
0	7768461		776846											30301

```
0      9791151      979115                                                    30501
0.87941      0.97052      0.97983      0.99994                               31001
0.94351      0.99872      0.99993                                            31101
0.95071      0.99932      0.99993                                            31201
0.12111      0.32452      0.55213      0.74314      0.87145      0.94326     31401
0.97777      0.99218      0.99759      0.999310     0.999911                 31402
0.036201     0.049302     0.055903     0.132904     0.173705     0.275306    31701
0.310607     0.384208     0.390109     0.521410     0.583811     0.594912    31702
0.609513     0.624114     0.761015     0.765516     0.773017     0.793718    31703
0.864619     0.905420     0.916021     0.984922     0.996523     0.997024    31704
0.999925                                                                     31705
0.024102     0.048203     0.095404     0.180705     0.494006     0.686707    31801
0.831313     0.855412     0.879515     0.975919     0.999920                 31802
0.243501     0.268502     0.309003     0.370804     0.496305     0.578406    31901
0.640207     0.711608     0.745409     0.817310     0.845911     0.872712    31902
0.881013     0.897614     0.919715     0.921616     0.930817     0.934518    31903
0.951119     0.967720     0.973221     0.983422     0.984323     0.985224    31904
0.999925                                                                     31905
0.208701     0.323202     0.343403     0.432404     0.552005     0.670106    32001
0.741407     0.823908     0.844009     0.884110     0.904211     0.933112    32002
0.955413     0.968814     0.971015     0.973316     0.979917     0.984420    32003
0.988921     0.991122     0.993925                                            32004
0.270501     0.286902     0.330603     0.448104     0.546405     0.603806    32101
0.671307     0.781408     0.789609     0.847010     0.871611     0.893412    32102
0.907113     0.923514     0.937215     0.939916     0.956317     0.964519    32103
0.987220     0.988322     0.989123     0.999925                               32104
0423 000  0424 013  0425 059  0501 062  0502 345  0503 012                   32509
0504 026  0505 000  0506 037  0507 025  0508 000  0509 012                   32510
0510 271  0511 012  0512 012  0513 012  0514 012  0515 012                   32511
0516 037  0517 111  0601 045  0602 030  0603 005  0604 000                   32512
0423 000  0424 000  0425 000  0501 000  0502 286  0503 000                   32609
0504 429  0505 000  0506 000  0507 000  0508 000  0509 000                   32610
0510 000  0511 000  0512 000  0513 000  0514 000  0515 000                   32611
0516 000  0517 286  0601 000  0602 077  0603 000  0604 000                   32612
0423 000  0424 000  0425 000  0501 192  0502 015  0503 089                   32709
0504 096  0505 022  0506 111  0507 067  0508 007  0509 007                   32710
0510 230  0511 015  0512 003  0513 022  0514 007  0515 015                   32711
0516 096  0517 007  0601 034  0602 034  0603 011  0604 056                   32712
0423 000  0424 000  0425 045  0501 186  0502 037  0503 019                   32809
0504 031  0505 037  0506 130  0507 075  0508 037  0509 000                   32810
0510 261  0511 019  0512 000  0513 019  0514 000  0515 019                   32811
0516 112  0517 019  0601 038  0602 019  0603 000  0604 057                   32812
0423 000  0424 000  0425 000  0501 152  0502 030  0503 030                   32909
0504 000  0505 030  0506 030  0507 152  0508 000  0509 000                   32910
0510 273  0511 061  0512 030  0513 000  0514 030  0515 061                   32911
0516 091  0517 030  0601 048  0602 048  0603 000  0604 095                   32912
0504 817057 0505  9509990506  9501000507  9507050508  9509990509  950999    33710
0504 0430370505  0080330506  0100200507  0030380508  0040130509  004012    34310
0504 1953790505  9999990506  7507500507  8008000508  0000000509  000000    34710
0504 4443440505  8003200506  5890000507  0000000508  2001350509  800320    35210
0504 0310000505  0080000506  0120000507  0180000508  0040000509  004000    35310
0504 0001010505  0006060506  0002000507  0002120508  0003070509  000505    35410
1      9999992      8997765      9744711      9999996      9030811      034649    40201
```

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21     987644                                                                    40202
0      7764671      776467                                                       40301
0      9786231      978623                                                       40501
0.87921      0.99042      0.99983      0.99994                                  41001
0.94361      0.99872      0.99993                                               41101
0.95091      0.99932      0.99993                                               41201
0.12071      0.32362      0.55113      0.74233      0.87095      0.94296         41401
0.97757      0.99218      0.99759      0.999310     0.999911                     41402
0.036201     0.049202     0.055803     0.132604     0.175305     0.276706        41701
0.311907     0.385203     0.391209     0.522310     0.584611     0.595712        41702
0.610213     0.624814     0.761415     0.765916     0.773517     0.794118        41703
0.864919     0.965620     0.916121     0.984922     0.996523     0.997024        41704
0.999925                                                                        41705
0.023502     0.047003     0.094004     0.201105     0.506606     0.694507        41801
0.875510     0.959012     0.882515     0.976519     0.999920                     41802
0.244201     0.269202     0.309903     0.371804     0.495005     0.577306        41901
0.639307     0.739808     0.744709     0.816910     0.845511     0.872412        41902
0.880713     0.997314     0.919515     0.921416     0.930617     0.934318        41903
0.951019     0.967620     0.973221     0.983422     0.994323     0.995224        41904
0.999925                                                                        41905
0.279801     0.324402     0.384803     0.434004     0.550305     0.668906        42001
0.740507     0.823309     0.843409     0.883710     0.903811     0.932912        42002
0.955313     0.968714     0.979915     0.973216     0.979917     0.984373        42003
0.988821     0.991122     0.999925                                               42004
0.270101     0.286502     0.330103     0.447504     0.547105     0.604406        42101
0.691707     0.741708     0.789909     0.847210     0.871811     0.893612        42102
0.907213     0.923614     0.937215     0.940016     0.956317     0.964519        42103
0.967320     0.986422     0.989123     0.999 25                                  42104
0423 000  0424 013  0425 059  0501 059  0502 330  0503 012                      42509
0504 070  0505 000  0506 035  0507 024  0508 000  0509 012                      42510
0510 259  0511 012  0512 012  0513 012  0514 012  0515 012                      42511
0516 035  0517 105  0601 045  0602 030  0603 005  0604 000                      42512
0423 000  0424 000  0425 000  0501 000  0502 219  0503 000                      42609
0504 561  0505 000  0506 000  0507 000  0508 000  0509 000                      42610
0510 000  0511 000  0512 000  0513 000  0514 000  0515 000                      42611
0516 000  0517 219  0601 000  0602 077  0603 000  0604 000                      42612
0423 030  0424 000  0425 030  0501 197  0502 015  0503 091                      42709
0504 076  0505 023  0506 114  0507 064  0508 008  0509 008                      42710
0510 239  0511 015  0512 000  0513 023  0514 008  0515 015                      42711
0516 098  0517 008  0601 034  0602 034  0603 011  0604 056                      42712
0423 000  0424 000  0425 045  0501 192  0502 030  0503 019                      42809
0504 000  0505 038  0506 135  0507 077  0508 038  0509 000                      42810
0510 269  0511 019  0512 000  0513 019  0514 000  0515 019                      42811
0516 115  0517 019  0601 038  0602 019  0603 000  0604 057                      42812
0423 000  0424 000  0425 000  0501 149  0502 030  0503 030                      42909
0504 015  0505 030  0506 030  0507 149  0508 000  0509 000                      42910
0510 269  0511 060  0512 030  0513 000  0514 030  0515 060                      42911
0516 090  0517 030  0601 048  0602 048  0603 000  0604 095                      42912
0504 9290760505  9509990506  9503030507  9507050508  9509990509  950999      43710
0504 0500370505  0080330506  0100200507  0030340508  0040130509  004012      44310
0504 1233080505  9999990506  7507500507  9008000508  0000000509  000000      44710
0504 5223030505  8003200506  9890000507  0000000508  2001350509  800320      45210
0504 0520000505  0090000506  0120000507  0180000508  0340000509  004000      45310
0504 0001020505  0006060506  0002090507  0002120508  0003070509  000505      45410
```

APPENDIX VIII
MAIN ROTOR BLADE RANKING TABULATIONS

This appendix presents the output from six demonstration case runs of Job 12, Step 1, that were made to obtain a relative ranking of the current UH-1H and four alternate MRB configurations on the basis of their R and M characteristics.

Data inputs for each run are described in Figure 10, and the discussion of Job 12 is given in the Component Evaluation and Ranking Exercise section of this report.

On the following pages, four tabulations are presented sequentially for each case run. The fourth tabulation in each case is used to determine component relative ranking.

CASE 1

LIFE CYCLE YEAR	COMPONENT	ANNUAL COST IN APPLICABLE YEAR							
		O-IR	IR	RD	IN	RPC	PCC	TC	DMC
1									
	1	0.	0.	479028.	0.	0.	0.	0.	0.
	2	0.	0.	718542.	0.	0.	0.	0.	0.
	3	0.	0.	718542.	0.	0.	0.	0.	0.
	4	0.	0.	757533.	0.	0.	0.	0.	0.
	5	0.	0.	479028.	0.	0.	0.	0.	0.
2									
	1	0.	0.	479028.	0.	0.	0.	0.	0.
	2	0.	0.	718542.	0.	0.	0.	0.	0.
	3	0.	0.	718542.	0.	0.	0.	0.	0.
	4	0.	0.	757533.	0.	0.	0.	0.	0.
	5	0.	0.	479028.	0.	0.	0.	0.	0.
3									
	1	-201834.	1177972.	0.	2e594.	0.	0.	0.	0.
	2	-0.	3506970.	0.	2e600.	0.	0.	0.	0.
	3	201932.	1345303.	0.	2e60e.	0.	0.	0.	0.
	4	403963.	3000439.	0.	2e613.	0.	0.	0.	0.
	5	-0.	1120096.	0.	2e600.	0.	0.	0.	0.
4									
	1	-201834.	1177972.	0.	2e594.	12132.	246759.	20727.	3297.
	2	-0.	3506970.	0.	2e600.	12428.	612601.	19308.	3108.
	3	201932.	1345303.	0.	2e60e.	12489.	258827.	23693.	4702.
	4	403963.	3000439.	0.	2e613.	14e61.	529866.	22108.	5439.
	5	-0.	1120096.	0.	2e600.	9603.	567681.	44692.	1207.
5									
	1	-201834.	1177972.	0.	2e594.	12132.	246759.	20727.	3297.
	2	-0.	3506970.	0.	2e600.	12428.	612601.	19308.	3108.
	3	201932.	1345303.	0.	2e60e.	12489.	258827.	23693.	4702.
	4	403963.	3000439.	0.	2e613.	14e61.	529866.	22108.	5439.
	5	-0.	1120096.	0.	2e600.	9603.	567681.	44692.	1207.
6									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23693.	4702.
	4	0.	0.	0.	0.	14e61.	529866.	22108.	5439.
	5	0.	0.	0.	0.	9603.	567681.	44692.	1207.
7									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23693.	4702.
	4	0.	0.	0.	0.	14e61.	529866.	22108.	5439.
	5	0.	0.	0.	0.	9603.	567681.	44692.	1207.
8									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23693.	4702.
	4	0.	0.	0.	0.	14e61.	529866.	22108.	5439.
	5	0.	0.	0.	0.	9603.	567681.	44692.	1207.
9									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23693.	4702.
	4	0.	0.	0.	0.	14e61.	529866.	22108.	5439.
	5	0.	0.	0.	0.	9603.	567681.	44692.	1207.
10									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23693.	4702.
	4	0.	0.	0.	0.	14e61.	529866.	22108.	5439.
	5	0.	0.	0.	0.	9603.	567681.	44692.	1207.
11									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23693.	4702.
	4	0.	0.	0.	0.	14e61.	529866.	22108.	5439.
	5	0.	0.	0.	0.	9603.	567681.	44692.	1207.
12									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23693.	4702.
	4	0.	0.	0.	0.	14e61.	529866.	22108.	5439.
	5	0.	0.	0.	0.	9603.	567681.	44692.	1207.
13									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23693.	4702.
	4	0.	0.	0.	0.	14e61.	529866.	22108.	5439.
	5	0.	0.	0.	0.	9603.	567681.	44692.	1207.

CASE 1 (continued)

LIFE CYCLE YEAR	COMPONENT	DIFFERENTIAL COST IN APPLICABLE YEAR							
		D-IR	IR	RD	IN	RPC	PCC	TC	ORC
1									
	1	0.	0.	0.	0.	0.	0.	0.	0.
	2	0.	0.	239514.	0.	0.	0.	0.	0.
	3	0.	0.	239514.	0.	0.	0.	0.	0.
	4	0.	0.	278905.	0.	0.	0.	0.	0.
	5	0.	0.	0.	0.	0.	0.	0.	0.
2									
	1	0.	0.	0.	0.	0.	0.	0.	0.
	2	0.	0.	239514.	0.	0.	0.	0.	0.
	3	0.	0.	239514.	0.	0.	0.	0.	0.
	4	0.	0.	278905.	0.	0.	0.	0.	0.
	5	0.	0.	0.	0.	0.	0.	0.	0.
3									
	1	0.	57876.	0.	0.	0.	0.	0.	0.
	2	201834.	2386874.	0.	6.	0.	0.	0.	0.
	3	403767.	225207.	0.	13.	0.	0.	0.	0.
	4	605797.	1880343.	0.	19.	0.	0.	0.	0.
	5	201834.	0.	0.	6.	0.	0.	0.	0.
4									
	1	0.	57876.	0.	0.	2529.	0.	1419.	2090.
	2	201834.	2386874.	0.	6.	2825.	365842.	0.	1902.
	3	403767.	225207.	0.	13.	2865.	12068.	4385.	3496.
	4	605797.	1880343.	0.	19.	5038.	283107.	2800.	4233.
	5	201834.	0.	0.	6.	0.	320922.	25384.	0.
5									
	1	0.	57876.	0.	0.	2529.	0.	1419.	2090.
	2	201834.	2386874.	0.	6.	2825.	365842.	0.	1902.
	3	403767.	225207.	0.	13.	2865.	12068.	4385.	3496.
	4	605797.	1880343.	0.	19.	5038.	283107.	2800.	4233.
	5	201834.	0.	0.	6.	0.	320922.	25384.	0.
6									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2865.	12068.	4385.	3496.
	4	0.	0.	0.	0.	5038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
7									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2865.	12068.	4385.	3496.
	4	0.	0.	0.	0.	5038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
8									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2865.	12068.	4385.	3496.
	4	0.	0.	0.	0.	5038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
9									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2865.	12068.	4385.	3496.
	4	0.	0.	0.	0.	5038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
10									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2865.	12068.	4385.	3496.
	4	0.	0.	0.	0.	5038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
11									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2865.	12068.	4385.	3496.
	4	0.	0.	0.	0.	5038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
12									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2865.	12068.	4385.	3496.
	4	0.	0.	0.	0.	5038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
13									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2865.	12068.	4385.	3496.
	4	0.	0.	0.	0.	5038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.

CASE 1 (continued)

LIFE CYCLE YEAR	DISCOUNT RATE AT.10	COMPONENT	DISCOUNTED D-IR	DIFFERENTIAL IR	COST IN RD	IN	APPLICABLE YEAR RPC	PCC	TC	DMC
1	1.000									
		1	0.	0.	0.	0.	0.	0.	0.	0.
		2	0.	0.	239514.	0.	0.	0.	0.	0.
		3	0.	0.	239514.	0.	0.	0.	0.	0.
		4	0.	0.	278505.	0.	0.	0.	0.	0.
		5	0.	0.	0.	0.	0.	0.	0.	0.
2	0.909									
		1	0.	0.	0.	0.	0.	0.	0.	0.
		2	0.	0.	217740.	0.	0.	0.	0.	0.
		3	0.	0.	217740.	0.	0.	0.	0.	0.
		4	0.	0.	253188.	0.	0.	0.	0.	0.
		5	0.	0.	0.	0.	0.	0.	0.	0.
3	0.826									
		1	0.	47831.	0.	0.	0.	0.	0.	0.
		2	186805.	1972623.	0.	9.	0.	0.	0.	0.
		3	333692.	186122.	0.	11.	0.	0.	0.	0.
		4	500639.	1594002.	0.	10.	0.	0.	0.	0.
		5	186805.	0.	0.	9.	0.	0.	0.	0.
4	0.751									
		1	0.	43483.	0.	0.	1900.	0.	1086.	1570.
		2	151641.	1793294.	0.	5.	2122.	274862.	0.	1429.
		3	303356.	169202.	0.	10.	2168.	9067.	3295.	2026.
		4	455144.	1612729.	0.	15.	3785.	212702.	2103.	3180.
		5	151641.	0.	0.	5.	0.	241113.	19072.	0.
5	0.683									
		1	0.	39530.	0.	0.	1727.	0.	988.	1428.
		2	137896.	1630267.	0.	4.	1929.	249875.	0.	1299.
		3	275778.	153820.	0.	9.	1971.	8243.	2995.	2368.
		4	413766.	1284290.	0.	13.	3441.	193366.	1912.	2891.
		5	137896.	0.	0.	4.	0.	219194.	17338.	0.
6	0.621									
		1	0.	0.	0.	0.	1570.	0.	881.	1298.
		2	0.	0.	0.	0.	1754.	227159.	0.	1181.
		3	0.	0.	0.	0.	1792.	7493.	2723.	2171.
		4	0.	0.	0.	0.	3128.	175787.	1738.	2628.
		5	0.	0.		0.	0.	199267.	15762.	0.
7	0.564									
		1	0.	0.	0.	0.	1427.	0.	801.	1180.
		2	0.	0.	0.	0.	1594.	206508.	0.	1073.
		3	0.	0.	0.	0.	1629.	6812.	2475.	1973.
		4	0.	0.	0.	0.	2844.	159807.	1580.	2389.
		5	0.	0.	0.	0.	0.	181157.	14329.	0.
8	0.513									
		1	0.	0.	0.	0.	1298.	0.	728.	1073.
		2	0.	0.	0.	0.	1449.	187735.	0.	976.
		3	0.	0.	0.	0.	1481.	6193.	2250.	1794.
		4	0.	0.	0.	0.	2585.	145279.	1437.	2172.
		5	0.	0.	0.	0.	0.	164684.	13026.	0.
9	0.467									
		1	0.	0.	0.	0.	1180.	0.	662.	975.
		2	0.	0.	0.	0.	1318.	170868.	0.	887.
		3	0.	0.	0.	0.	1346.	5630.	2046.	1631.
		4	0.	0.	0.	0.	2350.	132072.	1306.	1975.
		5	0.	0.	0.	0.	0.	149712.	11842.	0.
10	0.424									
		1	0.	0.	0.	0.	1072.	0.	602.	886.
		2	0.	0.	0.	0.	1198.	155153.	0.	806.
		3	0.	0.	0.	0.	1224.	5118.	1860.	1483.
		4	0.	0.	0.	0.	2137.	120065.	1187.	1795.
		5	0.	0.	0.	0.	0.	136102.	10765.	0.
11	0.386									
		1	0.	0.	0.	0.	975.	0.	547.	806.
		2	0.	0.	0.	0.	1089.	141044.	0.	733.
		3	0.	0.	0.	0.	1112.	4653.	1691.	1348.
		4	0.	0.	0.	0.	1942.	109150.	1079.	1632.
		5	0.	0.	0.	0.	0.	123729.	9787.	0.
12	0.350									
		1	0.	0.	0.	0.	886.	0.	497.	733.
		2	0.	0.	0.	0.	990.	128225.	0.	666.
		3	0.	0.	0.	0.	1011.	4230.	1537.	1225.
		4	0.	0.	0.	0.	1766.	99227.	981.	1483.
		5	0.	0.	0.	0.	0.	112481.	8897.	0.
13	0.319									
		1	0.	0.	0.	0.	806.	0.	452.	66..
		2	0.	0.	0.	0.	900.	116568.	0.	606.
		3	0.	0.	0.	0.	919.	3845.	1397.	1114.
		4	0.	0.	0.	0.	1605.	90207.	892.	1349.
		5	0.	0.	0.	0.	0.	102256.	8088.	0.

CASE 1 (continued)

LIFE CYCLE YEAR	TOTAL DISCOUNTED DIFFERENTIAL COST IN APPLICABLE YEAR				
COMPONENT--	1	2	3	4	5
1	0.	239214.	239514.	278505.	0.
2	0.	217740.	217740.	253186.	0.
3	47831.	2139434.	518824.	2054677.	166811.
4	48019.	2223353.	489723.	2089659.	411831.
5	43654.	2021233.	445203.	1899690.	374392.
6	3749.	230094.	14179.	193282.	215029.
7	3408.	209176.	12593.	166620.	195481.
8	3099.	190160.	11718.	151473.	177710.
9	2817.	172873.	10653.	137702.	161554.
10	2561.	157157.	9684.	125184.	146868.
11	2328.	142870.	8804.	113804.	133516.
12	2116.	129882.	8003.	103458.	121378.
13	1924.	118074.	7276.	94053.	110344.
TOTAL DISCOUNTED DIFFERENTIAL LIFE CYCLE EFFECTIVE COST INFLUENCE, $CI	101507.	8191356.	1995213.	7051292.	2214913.
SPARES	81	55	63	58	147

CASE 2

LIFE CYCLE YEAR	COMPONENT	ANNUAL COST IN APPLICABLE YEAR							
		D-IR	IR	RD	IN	RPC	PCC	TC	DMC
1									
	1	0.	0.	479328.	0.	0.	0.	0.	0.
	2	0.	0.	718942.	0.	0.	0.	0.	0.
	3	0.	0.	718942.	0.	0.	0.	0.	0.
	4	0.	0.	757933.	0.	0.	0.	0.	0.
	5	0.	0.	479328.	0.	0.	0.	0.	0.
2									
	1	0.	0.	479328.	0.	0.	0.	0.	0.
	2	0.	0.	718942.	0.	0.	0.	0.	0.
	3	0.	0.	718942.	0.	0.	0.	0.	0.
	4	0.	0.	757931.	0.	0.	0.	0.	0.
	5	0.	0.	479324.	0.	0.	0.	0.	0.
3									
	1	-403869.	2350077.	0.	53187.	0.	0.	0.	0.
	2	-0.	699703.	0.	53200.	0.	0.	0	0.
	3	403869.	2681311.	0.	53213.	0.	0.	.	0.
	4	807926.	5986389.	0.	53226.	0.	0.	0.	0.
	5	-0.	2231919.	0.	53200.	0.	0.	0.	0.
4									
	1	-403869.	2350077.	0.	53187.	24264.	493518.	41455.	6593.
	2	-0.	699703.	0.	53200.	24656.	1225202.	38616.	6216.
	3	403865.	2681311.	0.	53213.	24977.	517655.	47386.	9405.
	4	807926.	5986389.	0.	53226.	29283.	1059732.	44215.	10878.
	5	-0.	2231919.	0.	53200.	19206.	1135362.	89385.	2413.
5									
	1	-403869.	2350077.	0.	53187.	24264.	493518.	41455.	6593.
	2	-0.	699703.	0.	53200.	24656.	1225202.	38616.	6216.
	3	403865.	2681311	0.	53213.	24977.	517655.	47386.	9405.
	4	807926.	5986389.	0.	53226.	29283.	1059732.	44215.	10878.
	5	-0.	2231919.	0.	53200.	19206.	1135362.	89385.	2413.
6									
	1	0.	0.	0.	0.	24264.	493518.	41455.	6593.
	2	0.	0.	0.	0.	24656.	1225202.	38616.	6216.
	3	0.	0.	0.	0.	24977.	517655.	47386.	9405.
	4	0.	0.	0.	0.	29283.	1059732.	44215.	10878.
	5	0.	0.	0.	0.	19206.	1135362.	89385.	2413.
7									
	1	0.	0.	0.	0.	24264.	493518.	41455.	6593.
	2	0.	0.	0.	0.	24656.	1225202.	38616.	6216.
	3	0.	0.	0.	0.	24977.	517655.	47386.	9405.
	4	0.	0.	0.	0.	29283.	1059732.	44215.	10878.
	5	0.	0.	0.	0.	19206.	1135362.	89385.	2413.
8									
	1	0.	0.	0.	0.	24264.	493518.	41455.	6593.
	2	0.	0.	0.	0.	24656.	1225202.	38616.	6216.
	3	0.	0.	0.	0.	24977.	517655.	47386.	9405.
	4	0.	0.	0.	0.	29283.	1059732.	44215.	10878.
	5	0.	0.	0.	0.	19206.	1135362.	89385.	2413.
9									
	1	0.	0.	0.	0.	24264.	493518.	41455.	6593.
	2	0.	0.	0.	0.	24656.	1225202.	38616.	6216.
	3	0.	0.	0.	0.	24977.	517655.	47386.	9405.
	4	0.	0.	0.	0.	29283.	1059732.	44215.	10878.
	5	0.	0.	0.	0.	19206.	1135362.	89385.	2413.
10									
	1	0.	0.	0.	0.	24264.	493518.	41455.	6593.
	2	0.	0.	0.	0.	24656.	1225202.	38616.	6216.
	3	0.	0.	0.	0.	24977.	517655.	47386.	9405.
	4	0.	0.	0.	0.	29283.	1059732.	44215.	10878.
	5	0.	0.	0.	0.	19206.	1135362.	89385.	2413.
11									
	1	0.	0.	0.	0.	24264.	493518.	41455.	6593.
	2	0.	0.	0.	0.	24656.	1225202.	38616.	6216.
	3	0.	0.	0.	0.	24977.	517655.	47386.	9405.
	4	0.	0.	0.	0.	29283.	1059732.	44215.	10878.
	5	0.	0.	0.	0.	19206.	1135362.	89385.	2413.
12									
	1	0.	0.	0.	0.	24264.	493518.	41455.	6593.
	2	0.	0.	0.	0.	24656.	1225202.	38616.	6216.
	3	0.	0.	0.	0.	24977.	517655.	47386.	9405.
	4	0.	0.	0.	0.	29283.	1059732.	44215.	10878.
	5	0.	0.	0.	0.	19206.	1135362.	89385.	2413.
13									
	1	0.	0.	0.	0.	24264.	493518.	41455.	6593.
	2	0.	0.	0.	0.	24656.	1225202.	38616.	6216.
	3	0.	0.	0.	0.	24977.	517655.	47386.	9405.
	4	0.	0.	0.	0.	29283.	1059732.	44215.	10878.
	5	0.	0.	0.	0.	19206.	1135362.	89385.	2413.

CASE 3 (continued)

LIFE CYCLE YEAR	COMPONENT	DIFFERENTIAL COST IN APPLICABLE YEAR							
		O-IR	IR	RD	IN	RPC	PCC	TC	ONC
1									
	1	0.	0.	0.	0.	0.	0.	0.	0.
	2	0.	0.	239514.	0.	0.	0.	0.	0.
	3	0.	0.	239514.	0.	0.	0.	0.	0.
	4	0.	0.	278505.	0.	0.	0.	0.	0.
	5	0.	0.	0.	0.	0.	0.	0.	0.
2									
	1	0.	0.	0.	0.	0.	0.	0.	0.
	2	0.	0.	239514.	0.	0.	0.	0.	0.
	3	0.	0.	239514.	0.	0.	0.	0.	0.
	4	0.	0.	278505.	0.	0.	0.	0.	0.
	5	0.	0.	0.	0.	0.	0.	0.	0.
3									
	1	0.	118162.	0.	0.	0.	0.	0.	0.
	2	403669.	476089.	0.	13.	0.	0.	0.	0.
	3	807336.	440396.	0.	26.	0.	0.	0.	0.
	4	1211995.	379447.	0.	39.	0.	0.	0.	0.
	5	403669.	0.	0.	13.	0.	0.	0.	0.
4									
	1	0.	118162.	0.	0.	5057.	0.	2839.	4180.
	2	403669.	476089.	0.	13.	5649.	731684.	0.	3803.
	3	807336.	440396.	0.	26.	5771.	24136.	8770.	6992.
	4	1211995.	379447.	0.	39.	10078.	566214.	5599.	8465.
	5	403669.	0.	0.	13.	0.	641844.	50769.	0.
5									
	1	0.	118162.	0.	0.	5057.	0.	2839.	4180.
	2	403669.	476089.	0.	13.	5649.	731684.	0.	3803.
	3	807336.	440396.	0.	26.	5771.	24136.	8770.	6992.
	4	1211995.	379447.	0.	39.	10078.	566214.	5599.	8465.
	5	403669.	0.	0.	13.	0.	641844.	50769.	0.
6									
	1	0.	0.	0.	0.	5057.	0.	2839.	4180.
	2	0.	0.	0.	0.	5649.	731684.	0.	3803.
	3	0.	0.	0.	0.	5771.	24136.	8770.	6992.
	4	0.	0.	0.	0.	10078.	566214.	5599.	8465.
	5	0.	0.	0.	0.	0.	641844.	50769.	0.
7									
	1	0.	0.	0.	0.	5057.	0.	2839.	4180.
	2	0.	0.	0.	0.	5649.	731684.	0.	3803.
	3	0.	0.	0.	0.	5771.	24136.	8770.	6992.
	4	0.	0.	0.	0.	10078.	566214.	5599.	8465.
	5	0.	0.	0.	0.	0.	641844.	50769.	0.
8									
	1	0.	0.	0.	0.	5057.	0.	2839.	4180.
	2	0.	0.	0.	0.	5649.	731684.	0.	3803.
	3	0.	0.	0.	0.	5771.	24136.	8770.	6992.
	4	0.	0.	0.	0.	10078.	566214.	5599.	8465.
	5	0.	0.	0.	0.	0.	641844.	50769.	0.
9									
	1	0.	0.	0.	0.	5057.	0.	2839.	4180.
	2	0.	0.	0.	0.	5649.	731684.	0.	3803.
	3	0.	0.	0.	0.	5771.	24136.	8770.	6992.
	4	0.	0.	0.	0.	10078.	566214.	5599.	8465.
	5	0.	0.	0.	0.	0.	641844.	50769.	0.
10									
	1	0.	0.	0.	0.	5057.	0.	2839.	4180.
	2	0.	0.	0.	0.	5649.	731684.	0.	3803.
	3	0.	0.	0.	0.	5771.	24136.	8770.	6992.
	4	0.	0.	0.	0.	10078.	566214.	5599.	8465.
	5	0.	0.	0.	0.	0.	641844.	50769.	0.
11									
	1	0.	0.	0.	0.	5057.	0.	2839.	4180.
	2	0.	0.	0.	0.	5649.	731684.	0.	3803.
	3	0.	0.	0.	0.	5771.	24136.	8770.	6992.
	4	0.	0.	0.	0.	10078.	566214.	5599.	8465.
	5	0.	0.	0.	0.	0.	641844.	50769.	0.
12									
	1	0.	0.	0.	0.	5057.	0.	2839.	4180.
	2	0.	0.	0.	0.	5649.	731684.	0.	3803.
	3	0.	0.	0.	0.	5771.	24136.	8770.	6992.
	4	0.	0.	0.	0.	10078.	566214.	5599.	8465.
	5	0.	0.	0.	0.	0.	641844.	50769.	0.
13									
	1	0.	0.	0.	0.	5057.	0.	2839.	4180.
	2	0.	0.	0.	0.	5649.	731684.	0.	3803.
	3	0.	0.	0.	0.	5771.	24136.	8770.	6992.
	4	0.	0.	0.	0.	10078.	566214.	5599.	8465.
	5	0.	0.	0.	0.	0.	641844.	50769.	0.

CASE 2 (continued)

LIFE CYCLE YEAR	DISCOUNT RATE AT.10	COMPONENT	DISCOUNTED DIFFERENTIAL COST IN APPLICABLE YEAR							
			O-IR	IR	RD	IN	RPC	PCC	TC	DRC
1	1.000									
		1	0.	0.	0.	0.	0.	0.	0.	0.
		2	0.	0.	239514.	0.	0.	0.	0.	0.
		3	0.	0.	239514.	0.	0.	0.	0.	0.
		4	0.	0.	276505.	0.	0.	0.	0.	0.
		5	0.	0.	0.	0.	0.	0.	0.	0.
2	0.909									
		1	0.	0.	0.	0.	0.	0.	0.	0.
		2	0.	0.	217740.	0.	0.	0.	0.	0.
		3	0.	0.	217740.	0.	0.	0.	0.	0.
		4	0.	0.	251386.	0.	0.	0.	0.	0.
		5	0.	0.	0.	0.	0.	0.	0.	0.
3	0.826									
		1	0.	97695.	0.	0.	0.	0.	0.	0.
		2	333611.	3938093.	0.	17.	0.	0.	0.	0.
		3	667383.	3714402.	0.	24.	0.	0.	0.	0.
		4	1001318.	3102871.	0.	32.	0.	0.	0.	0.
		5	333611.	0.	0.	11.	0.	0.	0.	0.
4	0.751									
		1	0.	68777.	0.	0.	3800.	0.	2137.	3141.
		2	303282.	3580082.	0.	10.	4244.	540725.	0.	2857.
		3	606712.	337638.	0.	19.	4338.	18134.	6589.	9253.
		4	910269.	2820792.	0.	29.	7571.	425405.	4207.	6360.
		5	303282.	0.	0.	10.	0.	482227.	38143.	0.
5	0.683									
		1	0.	80706.	0.	0.	3494.	0.	1939.	2859.
		2	275711.	3254620.	0.	9.	3859.	499750.	0.	2598.
		3	551596.	306944.	0.	18.	3941.	16485.	5990.	4775.
		4	827535.	2564356.	0.	26.	6882.	386732.	3824.	5782.
		5	275711.	0.	0.	9.	0.	438388.	34676.	0.
6	0.621									
		1	0.	0.	0.	0.	3140.	0.	1763.	2598.
		2	0.	0.	0.	0.	3508.	454316.	0.	2361.
		3	0.	0.	0.	0.	3583.	14987.	5446.	4341.
		4	0.	0.	0.	0.	6257.	351574.	3477.	5256.
		5	0.	0.	0.	0.	0.	398534.	31523.	0.
7	0.564									
		1	0.	0.	0.	0.	2855.	0.	1602.	2360.
		2	0.	0.	0.	0.	3189.	413018.	0.	2147.
		3	0.	0.	0.	0.	3257.	13624.	4951.	3947.
		4	0.	0.	0.	0.	5688.	319613.	3161.	4778.
		5	0.	0.	0.	0.	0.	362304.	28658.	0.
8	0.513									
		1	0.	0.	0.	0.	2595.	0.	1457.	2145.
		2	0.	0.	0.	0.	2899.	375469.	0.	1952.
		3	0.	0.	0.	0.	2961.	12386.	4501.	3588.
		4	0.	0.	0.	0.	5171.	290597.	2873.	4344.
		5	0.	0.	0.	0.	0.	329367.	26052.	0.
9	0.467									
		1	0.	0.	0.	0.	2359.	0.	1324.	1950.
		2	0.	0.	0.	0.	2635.	341336.	0.	1774.
		3	0.	0.	0.	0.	2692.	11260.	4091.	3262.
		4	0.	0.	0.	0.	4701.	264143.	2612.	3949.
		5	0.	0.	0.	0.	0.	299429.	23684.	0.
10	0.424									
		1	0.	0.	0.	0.	2145.	0.	1204.	1773.
		2	0.	0.	0.	0.	2396.	310305.	0.	1613.
		3	0.	0.	0.	0.	2447.	10236.	3720.	2965.
		4	0.	0.	0.	0.	4273.	240190.	2375.	3590.
		5	0.	0.	0.	0.	0.	272204.	21531.	0.
11	0.386									
		1	0.	0.	0.	0.	1950.	0.	1094.	1612.
		2	0.	0.	0.	0.	2178.	282096.	0.	1466.
		3	0.	0.	0.	0.	2225.	9306.	3381.	2696.
		4	0.	0.	0.	0.	3885.	218300.	2159.	3264.
		5	0.	0.	0.	0.	0.	247459.	19574.	0.
12	0.350									
		1	0.	0.	0.	0.	1773.	0.	995.	1465.
		2	0.	0.	0.	0.	1980.	256451.	0.	1333.
		3	0.	0.	0.	0.	2023.	8460.	3074.	2451.
		4	0.	0.	0.	0.	3532.	198459.	1962.	2967.
		5	0.	0.	0.	0.	0.	224982.	17794.	0.
13	0.319									
		1	0.	0.	0.	0.	1611.	0.	904.	1332.
		2	0.	0.	0.	0.	1800.	233137.	0.	1212.
		3	0.	0.	0.	0.	1839.	691.	2795.	2228.
		4	0.	0.	0.	0.	3211.	180413.	1784.	2697.
		5	0.	0.	0.	0.	0.	204511.	16176.	0.

CASE 2 (continued)

LIFE CYCLE YEAR	TOTAL DISCOUNTED DIFFERENTIAL COST IN APPLICABLE YEAR				
COMPONENT--	1	2	3	4	5
1	0.	239514.	239514.	278505.	0.
2	0.	217740.	217740.	253186.	0.
3	97655.	4271711.	1038806.	4104221.	333621.
4	97850.	4443200.	978681.	4174652.	823662.
5	88955.	4036946.	889710.	3795139.	748784.
6	7499.	480187.	28357.	366564.	430058.
7	6817.	418352.	25779.	333240.	390962.
8	6197.	380320.	23436.	302945.	355420.
9	5634.	345745.	21305.	275405.	323109.
10	5122.	314314.	19368.	250368.	293735.
11	4656.	285740.	17607.	227607.	267032.
12	4233.	259764.	16007.	206916.	242756.
13	3846.	236149.	14552.	188105.	220688.
TOTAL DISCOUNTED DIFFERENTIAL LIFE CYCLE EFFECTIVE COST INFLUENCE, ECI	328464.	15906281.	3530862.	14756853.	4429826.
SPARES	117	105	119	111	286

CASE 3

LIFE CYCLE YEAR	COMPONENT	ANNUAL COST IN APPLICABLE YEAR							
		D-IR	IR	RD	IM	MPC	PCC	TC	OMC
1									
	1	0.	0.	479028.	0.	0.	0.	0.	0.
	2	0.	0.	718542.	0.	0.	0.	0.	0.
	3	0.	0.	718542.	0.	0.	0.	0.	0.
	4	0.	0.	957333.	0.	0.	0.	0.	0.
	5	0.	0.	479028.	0.	0.	0.	0.	0.
2									
	1	0.	0.	479 28.	0.	0.	0.	0.	0.
	2	0.	0.	718,42.	0.	0.	0.	0.	0.
	3	0.	0.	718542.	0.	0.	0.	0.	0.
	4	0.	0.	957333.	0.	0.	0.	0.	0.
	5	0.	0.	479028.	0.	0.	0.	0.	0.
3									
	1	-807338.	4691940.	0.	106374.	0.	0.	0.	0.
	2	-0.	13986908.	0.	106400.	0.	0.	0.	0.
	3	807730.	9353325.	0.	106426.	0.	0.	0.	0.
	4	1615851.	11949596.	0.	106452.	0.	0.	0.	0.
	5	-0.	4490379.	0.	106400.	0.	0.	0.	0.
4									
	1	-807338.	4691940.	0.	106374.	48527.	987037.	82909.	13167.
	2	-0.	13986908.	0.	106400.	49711.	2450404.	77232.	12432.
	3	807730.	9353325.	0.	106426.	49954.	1035309.	94773.	18809.
	4	1615851.	11949596.	0.	106452.	58566.	2119465.	88430.	21756.
	5	-0.	4490379.	0.	106400.	38413.	2270724.	178769.	4826.
5									
	1	-807338.	4691940.	0.	106374.	48527.	987037.	82909.	13167.
	2	-0.	13986908.	0.	106400.	49711.	2450404.	77232.	12432.
	3	807730.	9353325.	0.	106426.	49954.	1035309.	94773.	18809.
	4	1615851.	11949596.	0.	106452.	58566.	2119465.	88430.	21756.
	5	-0.	4490379.	0.	106400.	38413.	2270724.	178769.	4826.
6									
	1	0.	0.	0.	0.	48527.	987037.	82909.	13167.
	2	0.	0.	0.	0.	49711.	2450404.	77232.	12432.
	3	0.	0.	0.	0.	49954.	1035309.	94773.	18809.
	4	0.	0.	0.	0.	58566.	2119465.	88430.	21756.
	5	0.	0.	0.	0.	38413.	2270724.	178769.	4826.
7									
	1	0.	0.	0.	0.	48527.	987037.	82909.	13167.
	2	0.	0.	0.	0.	49711.	2450404.	77232.	12432.
	3	0.	0.	0.	0.	49954.	1035309.	94773.	18809.
	4	0.	0.	0.	0.	58566.	2119465.	88430.	21756.
	5	0.	0.	0.	0.	38413.	2270724.	178769.	4826.
8									
	1	0.	0.	0.	0.	48527.	987037.	82909.	13167.
	2	0.	0.	0.	0.	49711.	2450404.	77232.	12432.
	3	0.	0.	0.	0.	49954.	1035309.	94773.	18809.
	4	0.	0.	0.	0.	58566.	2119465.	88430.	21756.
	5	0.	0.	0.	0.	38413.	2270724.	178769.	4826.
9									
	1	0.	0.	0.	0.	48527.	987037.	82909.	13167.
	2	0.	0.	0.	0.	49711.	2450404.	77232.	12432.
	3	0.	0.	0.	0.	49954.	1035309.	94773.	18809.
	4	0.	0.	0.	0.	58566.	2119465.	88430.	21756.
	5	0.	0.	0.	0.	38413.	2270724.	178769.	4826.
10									
	1	0.	0.	0.	0.	48527.	987037.	82909.	13167.
	2	0.	0.	0.	0.	49711.	2450404.	77232.	12432.
	3	0.	0.	0.	0.	49954.	1035309.	94773.	18809.
	4	0.	0.	0.	0.	58566.	2119465.	88430.	21756.
	5	0.	0.	0.	0.	38413.	2270724.	178769.	4826.
11									
	1	0.	0.	0.	0.	48527.	987037.	82909.	13167.
	2	0.	0.	0.	0.	49711.	2450404.	77232.	12432.
	3	0.	0.	0.	0.	49954.	1035309.	94773.	18809.
	4	0.	0.	0.	0.	58566.	2119465.	88430.	21756.
	5	0.	0.	0.	0.	38413.	2270724.	178769.	4826.
12									
	1	0	0.	0.	0.	48527.	987037.	82909.	13167.
	2	0.	0.	0.	0.	49711.	2450404.	77232.	12432.
	3	0.	0.	0.	0.	49954.	1035309.	94773.	18809.
	4	0.	0.	0.	0.	58566.	2119465.	88430.	21756.
	5	0.	0.	0.	0.	38413.	2270724.	178769.	4826.
13									
	1	0.	0.	0.	0.	48527.	987037.	82909.	13167.
	2	0.	0.	0.	0.	49711.	2450404.	77232.	12432.
	3	0.	0.	0.	0.	49954.	1035309.	94773.	18809.
	4	0.	0.	0.	0.	58566.	2119465.	88430.	21756.
	5	0.	0.	0.	0.	38413.	2270724.	178769.	4826.

CASE 3 (continued)

LIFE CYCLE YEAR	COMPONENT	DIFFERENTIAL COST IN APPLICABLE YEAR							
		O-IR	IR	RD	IN	MPC	PCC	TC	OMC
1									
	1	0.	0.	0.	0.	0.	0.	0.	0.
	2	0.	0.	239514.	0.	0.	0.	0.	0.
	3	0.	0.	239514.	0.	0.	0.	0.	0.
	4	0.	0.	278505.	0.	0.	0.	0.	0.
	5	0.	0.	0.	0.	0.	0.	0.	0.
2									
	1	0.	0.	0.	0.	0.	0.	0.	0.
	2	0.	0.	239514.	0.	0.	0.	0.	0.
	3	0.	0.	239514.	0.	0.	0.	0.	0.
	4	0.	0.	278505.	0.	0.	0.	0.	0.
	5	0.	0.	0.	0.	0.	0.	0.	0.
3									
	1	0.	241561.	0.	0.	0.	0.	0.	0.
	2	807338.	9516529.	0.	26.	0.	0.	0.	0.
	3	1815067.	902947.	0.	52.	0.	0.	0.	0.
	4	2423189.	7499214.	0.	77.	0.	0.	0.	0.
	5	807338.	0.	0.	26.	0.	0.	0.	0.
4									
	1	0.	241561.	0.	0.	10115.	0.	9677.	8361.
	2	807338.	9516529.	0.	26.	11299.	1463367.	0.	7606.
	3	1815067.	902947.	0.	52.	11541.	48273.	17541.	13983.
	4	2423189.	7499214.	0.	77.	20153.	1132428.	111198.	16930.
	5	807338.	0.	0.	26.	0.	1283687.	1015137.	0.
5									
	1	0.	241561.	0.	0.	10115.	0.	9677.	8361.
	2	807338.	9516529.	0.	26.	11299.	1463367.	0.	7606.
	3	1815067.	902947.	0.	52.	11541.	48273.	17541.	13983.
	4	2423189.	7499214.	0.	77.	20153.	1132428.	111198.	16930.
	5	807338.	0.	0.	26.	0.	1283687.	1015137.	0.
6									
	1	0.	0.	0.	0.	10115.	0.	9677.	8361.
	2	0.	0.	0.	0.	11299.	1463367.	0.	7606.
	3	0.	0.	0.	0.	11541.	48273.	17541.	13983.
	4	0.	0.	0.	0.	20153.	1132428.	111198.	16930.
	5	0.	0.	0.	0.	0.	1283687.	1015137.	0.
7									
	1	0.	0.	0.	0.	10115.	0.	9677.	8361.
	2	0.	0.	0.	0.	11299.	1463367.	0.	7606.
	3	0.	0.	0.	0.	11541.	48273.	17541.	13983.
	4	0.	0.	0.	0.	20153.	1132428.	111198.	16930.
	5	0.	0.	0.	0.	0.	1283687.	1015137.	0.
8									
	1	0.	0.	0.	0.	10115.	0.	9677.	8361.
	2	0.	0.	0.	0.	11299.	1463367.	0.	7606.
	3	0.	0.	0.	0.	11541.	48273.	17541.	13983.
	4	0.	0.	0.	0.	20153.	1132428.	111198.	16930.
	5	0.	0.	0.	0.	0.	1283687.	1015137.	0.
9									
	1	0.	0.	0.	0.	10115.	0.	9677.	8361.
	2	0.	0.	0.	0.	11299.	1463367.	0.	7606.
	3	0.	0.	0.	0.	11541.	48273.	17541.	13983.
	4	0.	0.	0.	0.	20153.	1132428.	111198.	16930.
	5	0.	0.	0.	0.	0.	1283687.	1015137	0.
10									
	1	0.	0.	0.	0.	10115.	0.	9677.	8361.
	2	0.	0.	0.	0.	11299.	1463367.	0.	7606.
	3	0.	0.	0.	0.	11541.	48273.	17541.	13983.
	4	0.	0.	0.	0.	20153.	1132428.	111198.	16930.
	5	0.	0.	0.	0.	0.	1283687.	1015137.	0.
11									
	1	0.	0.	0.	0.	10115.	0.	9677.	8361.
	2	0.	0.	0.	0.	11299.	1463367.	0.	7606.
	3	0.	0.	0.	0.	11541.	48273.	17541.	13983.
	4	0.	0.	0.	0.	20153.	1132428.	111198.	16930.
	5	0.	0.	0.	0.	0.	1283687.	1015137.	0.
12									
	1	0.	0.	0.	0.	10115.	0.	9677.	8361.
	2	0.	0.	0.	0.	11299.	1463367.	0	7606.
	3	0.	0.	0.	0.	11541.	48273.	17541.	13983.
	4	0.	0.	0.	0.	20153.	1132428.	111198.	16930.
	5	0.	0.	0.	0.	0.	1283687.	1015137.	0.
13									
	1	0.	0.	0.	0.	10115.	0.	9677.	8361.
	2	0.	0.	0.	0.	11299.	1463367.	0.	7606.
	3	0.	0.	0.	0.	11541.	48273.	17541.	13983.
	4	0.	0.	0.	0.	20153.	1132428.	111198.	16930.
	5	0.	0.	0.	0.	0.	1283687.	1015137.	0.

CASE 3 (continued)

LIFE CYCLE YEAR	DISCOUNT RATE AT.10	COMPONENT	DISCOUNTED DIFFERENTIAL COST IN APPLICABLE YEAR							
			D-ER	IR	RD	IN	MPC	PCC	TC	DMC
1	1.000									
		1	0.	0.	0.	0.	0.	0.	0.	0.
		2	0.	0.	239514.	0.	0.	0.	0.	0.
		3	0.	0.	239514.	0.	0.	0.	0.	0.
		4	0.	0.	278505.	0.	0.	0.	0.	0.
		5	0.	0.	0.	0.	0.	0.	0.	0.
2	0.909									
		1	0.	0.	0.	0.	0.	0.	0.	0.
		2	0.	0.	217740.	0.	0.	0.	0.	0.
		3	0.	0.	217740.	0.	0.	0.	0.	0.
		4	0.	0.	253188.	0.	0.	0.	0.	0.
		5	0.	0.	0.	0.	0.	0.	0.	0.
3	0.826									
		1	0.	198837.	0.	0.	0.	0.	0.	0.
		2	667221.	7864960.	0.	21.	0.	0.	0.	0.
		3	1334766.	7462237.	0.	43.	0.	0.	0.	0.
		4	2002836.	6197701.	0.	64.	0.	0.	0.	0.
		5	667221.	0.	0.	21.	0.	0.	0.	0.
4	0.751									
		1	0.	181489.	0.	0.	7599.	0.	4265.	6282.
		2	606565.	7149909.	0.	19.	8489.	1099649.	0.	5719.
		3	1213424.	6743397.	0.	39.	8671.	1b2b8.	13179.	10536.
		4	1620578.	5614273.	0.	58.	15141.	850810.	8414.	12720.
		5	606565.	0.	0.	19.	0.	9b4453.	7b287.	0.
5	0.683									
		1	0.	164993.	0.	0.	6909.	0.	3878.	5711.
		2	551423.	6499918.	0.	18.	7717.	999499.	0.	5195.
		3	1103113.	6136725.	0.	35.	7883.	32971.	11981.	9551.
		4	1655071.	5122067.	0.	53.	13765.	773464.	7649.	11564.
		5	551423.	0.	0.	18.	0.	876778.	69351.	0.
6	0.621									
		1	0.	0.	0.	0.	6280.	0.	3525.	5191.
		2	0.	0.	0.	0.	7015.	908636.	0.	4723.
		3	0.	0.	0.	0.	7166.	29974.	10892.	8683.
		4	0.	0.	0.	0.	12513.	703149.	6953.	10512.
		5	0.	0.	0.	0.	0.	797069.	63047.	0.
7	0.564									
		1	0.	0.	0.	0.	5710.	0.	3205.	4719.
		2	0.	0.	0.	0.	6378.	826033.	0.	4293.
		3	0.	0.	0.	0.	6515.	27249.	9901.	7893.
		4	0.	0.	0.	0.	11376.	639226.	6321.	9557.
		5	0.	0.	0.	0.	0.	724608.	57315.	0.
8	0.513									
		1	0.	0.	0.	0.	5190.	0.	2913.	4290.
		2	0.	0.	0.	0.	5798.	750939.	0.	3903.
		3	0.	0.	0.	0.	5923.	24772.	9001.	7178.
		4	0.	0.	0.	0.	10342.	581115.	5747.	8688.
		5	0.	0.	0.	0.	0.	658795.	52105.	0.
9	0.467									
		1	0.	0.	0.	0.	4719.	0.	2649.	3900.
		2	0.	0.	0.	0.	5271.	682672.	0.	3548.
		3	0.	0.	0.	0.	5384.	22520.	8183.	6523.
		4	0.	0.	0.	0.	9401.	528288.	5224.	7898.
		5	0.	0.	0.	0.	0.	598850.	47368.	0.
10	0.424									
		1	0.	0.	0.	0.	4290.	0.	2408.	3546.
		2	0.	0.	0.	0.	4792.	620810.	0.	3226.
		3	0.	0.	0.	0.	4895.	20472.	7439.	5930.
		4	0.	0.	0.	0.	8547.	480260.	4749.	7180.
		5	0.	0.	0.	0.	0.	544458.	43062.	0.
11	0.386									
		1	0.	0.	0.	0.	3900.	0.	2189.	3223.
		2	0.	0.	0.	0.	4356.	564191.	0.	2932.
		3	0.	0.	0.	0.	4450.	18611.	6763.	5391.
		4	0.	0.	0.	0.	7770.	436800.	4317.	6527.
		5	0.	0.	0.	0.	0.	494917.	39147.	0.
12	0.350									
		1	0.	0.	0.	0.	3549.	0.	1990.	2930.
		2	0.	0.	0.	0.	3960.	512901.	0.	2666.
		3	0.	0.	0.	0.	4045.	16919.	6148.	4901.
		4	0.	0.	0.	0.	7069.	396909.	3925.	5934.
		5	0.	0.	0.	0.	0.	449925.	35588.	0.
13	0.319									
		1	0.	0.	0.	0.	3223.	0.	1809.	2664.
		2	0.	0.	0.	0.	3600.	466274.	0.	2424.
		3	0.	0.	0.	0.	3677.	15381.	5589.	4456.
		4	0.	0.	0.	0.	6421.	360826.	3568.	5395.
		5	0.	0.	0.	0.	0.	409057.	32353.	0.

CASE 3 (continued)

LIFE CYCLE YEAR	TOTAL DISCOUNTED DIFFERENTIAL COST IN APPLICABLE YEAR				
COMPONENT--	1	2	3	4	5
1	0.	239514.	239514.	278505.	0.
2	0.	217740.	217740.	253186.	0.
3	199637.	8532143.	20810+6.	8200403.	667243.
4	199635.	8870146.	1960484.	8341994.	1647324.
5	181486.	8063769.	1782258.	7583631.	1497567.
6	14997.	920374.	56714.	733128.	860116.
7	13634.	836704.	51558.	666480.	781923.
8	12394.	760640.	46871.	605891.	710839.
9	11268.	691491.	42610.	550810.	646218.
10	10243.	628628.	38736.	500736.	587471.
11	9312.	571480.	35215.	455215.	534064.
12	8465.	519527.	32014.	413832.	485513.
13	7696.	472297.	29103.	376210.	441375.
TOTAL DISCOUNTED DIFFERENTIAL LIFE CYCLE EFFECTIVE COST INFLUENCE, ECI	668768.	31324+53.	6613863.	2896001b.	6859653.
SPARES	227	202	231	214	559

CASE 4

LIFE CYCLE YEAR	COMPONENT	ANNUAL COST IN APPLICABLE YEAR							
		O-IR	IR	RD	IN	MPC	PCC	TC	ORC
1									
	1	0.	0.	479028.	0.	0.	0.	0.	0.
	2	0.	0.	718542.	0.	0.	0.	0.	0.
	3	0.	0.	718542.	0.	0.	0.	0.	0.
	4	0.	0.	797933.	0.	0.	0.	0.	0.
	5	0.	0.	479028.	0.	0.	0.	0.	0.
2									
	1	0.	0.	479028.	0.	0.	0.	0.	0.
	2	0.	0.	718542.	0.	0.	0.	0.	0.
	3	0.	0.	718542.	0.	0.	0.	0.	0.
	4	0.	0.	797933.	0.	0.	0.	0.	0.
	5	0.	0.	479028.	0.	0.	0.	0.	0.
3									
	1	-201834.	1177972.	0.	2b594.	0.	0.	0.	0.
	2	-0.	3906970.	0.	2b00C.	0.	0.	0.	0.
	3	201932.	1345303.	0.	2b006.	0.	0.	0.	0.
	4	403963.	3000439.	0.	2b013.	0.	0.	0.	0.
	5	-0.	1120096.	0.	2b00C.	0.	0.	0.	0.
4									
	1	-201834.	1177972.	0.	2b594.	12132.	246759.	20727.	3297.
	2	-0.	3926970.	0.	2b00C.	12428.	612601.	19308.	3108.
	3	201932.	1345303.	0.	2b00b.	12489.	258827.	23b93.	4702.
	4	403963.	3000439.	0.	2bb13.	14b41.	529866.	22108.	9439.
	5	-0.	1120096.	0.	2b00C.	9b03.	5b7b81.	44b92.	1207.
5									
	1	-201834.	1177972	0.	2b594.	12132.	246759.	20727.	3297.
	2	-0.	3906973.	0.	2b00D.	12428.	612601.	19308.	3108.
	3	201932.	1345303.	0.	2b00b.	12489.	258827.	23b93.	4702.
	4	403963.	3000439.	0.	2bb13.	14b41.	529866.	22108.	9439.
	5	-0.	1120096.	0.	2b00D.	9b03.	5b7b81.	44b92.	1207.
6									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23b93.	4702.
	4	0.	0.	0.	0.	14b41.	529866.	22108.	9439.
	5	0.	0.	0.	0.	9b03.	5b7b81.	44b92.	1207.
7									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23b93.	4702.
	4	0.	0.	0.	0.	14b41.	529866.	22108.	9439.
	5	0.	0.	0.	0.	9b03.	5b7b81.	44b92.	1207.
8									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23b93.	4702.
	4	0.	0.	0.	0.	14b41.	529866.	22108.	9439.
	5	0.	0.	0.	0.	9b03.	5b7b81.	44b92.	1207.
9									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23b93.	4702.
	4	0.	0.	0.	0.	14b41.	529866.	22108.	9439.
	5	0.	0.	0.	0.	9b03.	5b7b81.	44b92.	1207.
10									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23b93.	4702.
	4	0.	0.	0.	0.	14b41.	529866.	22108.	9439.
	5	0.	0.	0.	0.	9b03.	5b7b81.	44b92.	1207.
11									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23b93.	4702.
	4	0.	0.	0.	0.	14b41.	529866.	22108.	9439.
	5	0.	0.	0.	0.	9b03.	5b7b81.	44b92.	1207.
12									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23b93.	4702.
	4	0.	0.	0.	0.	14b41.	529866.	22108.	9439.
	5	0.	0.	0.	0.	9b03.	5b7b81.	44b92.	1207.
13									
	1	0.	0.	0.	0.	12132.	246759.	20727.	3297.
	2	0.	0.	0.	0.	12428.	612601.	19308.	3108.
	3	0.	0.	0.	0.	12489.	258827.	23b93.	4702.
	4	0.	0.	0.	0.	14b41.	529866.	22108.	9439.
	5	0.	0.	0.	0.	9b03.	5b7b81.	44b92.	1207.

CA B 4 (continued)

LIFE CYCLE YEAR	COMPONENT	DIFFERENTIAL COST IN APPLICABLE YEAR							
		D-ER	IR	RD	IN	MPC	PCC	TC	DMC
1									
	1	0.	0.	0.	0.	0.	0.	0.	0.
	2	0.	0.	239514.	0.	0.	0.	0.	0.
	3	0.	0.	239514.	0.	0.	0.	0.	0.
	4	0.	0.	278905.	0.	0.	0.	0.	0.
	5	0.	0.	0.	0.	0.	0.	0.	0.
2									
	1	0.	0.	0.	0.	0.	0.	0.	0.
	2	0.	0.	239514.	0.	0.	0.	0.	0.
	3	0.	0.	239514.	0.	0.	0.	0.	0.
	4	0.	0.	278905.	0.	0.	0.	0.	0.
	5	0.	0.	0.	0.	0.	0.	0.	0.
3									
	1	0.	57876.	0.	0.	0.	0.	0.	0.
	2	201834.	2366876.	0.	0.	0.	0.	0.	0.
	3	403767.	225207.	0.	13.	0.	0.	0.	0.
	4	805797.	1860343.	0.	19.	0.	0.	0.	0.
	5	201834.	0.	0.	0.	0.	0.	0.	0.
4									
	1	0.	57876.	0.	0.	2529.	0.	1419.	2090.
	2	201834.	2366876.	0.	0.	2825.	365842.	0.	1902.
	3	403767.	225207.	0.	13.	2885.	12068.	4385.	3496.
	4	805797.	1860343.	0.	19.	9038.	283107.	2800.	4233.
	5	201834.	0.	0.	0.	0.	320922.	25384.	0.
5									
	1	0.	57876.	0.	0.	2529.	0.	1419.	2090.
	2	201834.	2366876.	0.	0.	2825.	365842.	0.	1902.
	3	403767.	225207.	0.	13.	2885.	12068.	4385.	3496.
	4	805797.	1860343.	0.	19.	9038.	283107.	2800.	4233.
	5	201834.	0.	0.	0.	0.	320922.	25384.	0.
6									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
	4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
7									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
	4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
8									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
	4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
9									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
	4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
10									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
	4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
11									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
	4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
12									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
	4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.
13									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	365842.	0.	1902.
	3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
	4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
	5	0.	0.	0.	0.	0.	320922.	25384.	0.

CASE 4 (continued)

LIFE CYCLE YEAR	DISCOUNT RATE AT.0	COMPONENT	DISCOUNTED D-ER	DIFFERENTIAL ER	RC	COST IN APPLICABLE YEAR IN	MPC	PCC	TC	OMC
1	1.000									
		1	0.	0.	0.	0.	0.	0.	0.	0.
		2	0.	0.	239514.	0.	0.	0.	0.	0.
		3	0.	0.	239514.	0.	0.	0.	0.	0.
		4	0.	0.	278509.	0.	0.	0.	0.	0.
		5	0.	0.	0.	0.	0.	0.	0.	0.
2	1.000									
		1	0.	0.	0.	0.	0.	0.	0.	0.
		2	0.	0.	239514.	0.	0.	0.	0.	0.
		3	0.	0.	239514.	0.	0.	0.	0.	0.
		4	0.	0.	278509.	0.	0.	0.	0.	0.
		5	0.	0.	0.	0.	0.	0.	0.	0.
3	1.000									
		1	0.	57876.	0.	0.	0.	0.	0.	0.
		2	201834.	2386874.	0.	0.	0.	0.	0.	0.
		3	403767.	225207.	0.	13.	0.	0.	0.	0.
		4	605797.	1860343.	0.	19.	0.	0.	0.	0.
		5	201834.	0.	0.	6.	0.	0.	0.	0.
4	1.000									
		1	0.	57876.	0.	0.	2529.	0.	1419.	2090.
		2	201834.	2386874.	0.	6.	2825.	365842.	0.	1902.
		3	403767.	225207.	0.	13.	2885.	12068.	4385.	3496.
		4	605797.	1860343.	0.	19.	9038.	283107.	2800.	4233.
		5	201834.	0.	0.	6.	0.	320922.	25384.	0.
5	1.000									
		1	0.	57876.	0.	0.	2529.	0.	1419.	2090.
		2	201834.	2386874.	0.	6.	2825.	365842.	0.	1902.
		3	403767.	225207.	0.	13.	2885.	12068.	4385.	3496.
		4	605797.	1860343.	0.	19.	9038.	283107.	2800.	4233.
		5	201834.	0.	0.	6.	0.	320922.	25384.	0.
6	1.000									
		1	0.	0.	0.	0.	2529.	0.	1419.	2090.
		2	0.	0.	0.	0.	2825.	365842.	0.	1902.
		3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
		4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
		5	0.	0.	0.	0.	0.	320922.	25384.	0.
7	1.000									
		1	0.	0.	0.	0.	2529.	0.	1419.	2090.
		2	0.	0.	0.	0.	2825.	365842.	0.	1902.
		3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
		4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
		5	0.	0.	0.	0.	0.	320922.	25384.	0.
8	1.000									
		1	0.	0.	0.	0.	2529.	0.	1419.	2090.
		2	0.	0.	0.	0.	2825.	365842.	0.	1902.
		3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
		4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
		5	0.	0.	0.	0.	0.	320922.	25384.	0.
9	1.000									
		1	0.	0.	0.	0.	2529.	0.	1419.	2090.
		2	0.	0.	0.	0.	2825.	365842.	0.	1902.
		3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
		4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
		5	0.	0.	0.	0.	0.	320922.	25384.	0.
10	1.000									
		1	0.	0.	0.	0.	2529.	0.	1419.	2090.
		2	0.	0.	0.	0.	2825.	365842.	0.	1902.
		3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
		4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
		5	0.	0.	0.	0.	0.	320922.	25384.	0.
11	1.000									
		1	0.	0.	0.	0.	2529.	0.	1419.	2090.
		2	0.	0.	0.	0.	2825.	365842.	0.	1902.
		3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
		4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
		5	0.	0.	0.	0.	0.	320922.	25384.	0.
12	1.000									
		1	0.	0.	0.	0.	2529.	0.	1419.	2090.
		2	0.	0.	0.	0.	2825.	365842.	0.	1902.
		3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
		4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
		5	0.	0.	0.	0.	0.	320922.	25384.	0.
13	1.000									
		1	0.	0.	0.	0.	2529.	0.	1419.	2090.
		2	0.	0.	0.	0.	2825.	365842.	0.	1902.
		3	0.	0.	0.	0.	2885.	12068.	4385.	3496.
		4	0.	0.	0.	0.	9038.	283107.	2800.	4233.
		5	0.	0.	0.	0.	0.	320922.	25384.	0.

CASE 4 (continued)

LIFE CYCLE YEAR	TOTAL DISCOUNTED DIFFERENTIAL COST IN APPLICABLE YEAR				
COMPONENT--	1	2	3	4	5
1	0.	239514.	239514.	278505.	0.
2	0.	239514.	239514.	278505.	0.
3	57876.	2586715.	628987.	2486159.	201841.
4	63914.	2959283.	651822.	2761337.	548147.
5	63914.	2959283.	651822.	2761337.	548147.
6	6038.	373568.	22835.	295177.	346306.
7	6038.	373568.	22835.	295177.	346306.
8	6038.	373568.	22835.	295177.	346306.
9	6038.	373568.	22835.	295177.	346306.
10	6038.	373568.	22835.	295177.	346306.
11	6038.	373568.	22835.	295177.	346306.
12	6038.	373568.	22835.	295177.	346306.
13	6038.	373568.	22835.	295177.	346306.
TOTAL DISCOUNTED DIFFERENTIAL LIFE CYCLE EFFECTIVE COST INFLUENCE, ECI	234009.	11990852.	2594335.	10967261.	4068585.
SPARES	61	55	63	58	147

CASE 6

LIFE CYCLE YEAR	COMPONENT	ANNUAL COST IN APPLICABLE YEAR							
		D-IR	IR	RD	IN	MPC	MCC	TC	VMC
1									
	1	0.	0.	479328.	0.	0.	0.	0.	0.
	2	0.	0.	718942.	0.	0.	0.	0.	0.
	3	0.	0.	718942.	0.	0.	0.	0.	0.
	4	0.	0.	757533.	0.	0.	0.	0.	0.
	5	0.	0.	479328.	0.	0.	0.	0.	0.
2									
	1	0.	0.	479328.	0.	0.	0.	0.	0.
	2	0.	0.	718942.	0.	0.	0.	0.	0.
	3	0.	0.	718942.	0.	0.	0.	0.	0.
	4	0.	0.	757533.	0.	0.	0.	0.	0.
	5	0.	0.	479328.	0.	0.	0.	0.	0.
3									
	1	-201834.	1295362.	0.	2e594.	0.	0.	0.	0.
	2	-0.	3857230.	0.	2e800.	0.	0.	0.	0.
	3	202099.	1479272.	0.	2e908.	0.	0.	0.	0.
	4	404130.	3299990.	0.	2e013.	0.	0.	0.	0.
	5	-0.	1120096.	0.	2e600.	0.	0.	0.	0.
4									
	1	-201834.	1295362.	0.	2e594.	12132.	27e007.	20727.	3297.
	2	-0.	3857230.	0.	2e800.	12e28.	672e21.	19308.	3108.
	3	202099.	1479272.	0.	2e908.	12e89.	283385.	23e93.	4702.
	4	404130.	3299990.	0.	2e013.	14e41.	580936.	22108.	5e39.
	5	-0.	1120096.	0.	2e600.	9e03.	5e7e81.	44e92.	12e7.
5									
	1	-201834.	1295362.	0.	2e594.	12132.	270007.	20727.	3297.
	2	-0.	3857230.	0.	2e800.	12e28.	672e21.	19308.	3108.
	3	202099.	1479272.	0.	2e908.	12e89.	283385.	23e93.	4702.
	4	404130.	3299990.	0.	2e013.	14e41.	580936.	22108.	5e39.
	5	-0.	1120096.	0.	2e600.	9e03.	5e7e81.	44e92.	12e7.
6									
	1	0.	0.	0.	0.	12132.	270007.	20727.	3297.
	2	0.	0.	0.	0.	12e28.	672e21.	19308.	3108.
	3	0.	0.	0.	0.	12e89.	283385.	23e93.	4702.
	4	0.	0.	0.	0.	14e41.	580936.	22108.	5e39.
	5	0.	0.	0.	0.	9e03.	5e7e81.	44e92.	12e7.
7									
	1	0.	0.	0.	0.	12132.	270007.	20727.	3297.
	2	0.	0.	0.	0.	12e28.	672e21.	19308.	3108.
	3	0.	0.	0.	0.	12e89.	283385.	23e93.	4702.
	4	0.	0.	0.	0.	14e41.	580936.	22108.	5e39.
	5	0.	0.	0.	0.	9e03.	5e7e81.	44e92.	12e7.
8									
	1	0.	0.	0.	0.	12132.	270007.	20727.	3297.
	2	0.	0.	0.	0.	12e28.	672e21.	19308.	3108.
	3	0.	0.	0.	0.	12e89.	283385.	23e93.	4702.
	4	0.	0.	0.	0.	14e41.	580936.	22108.	5e39.
	5	0.	0.	0.	0.	9e03.	5e7e81.	44e92.	12e7.
9									
	1	0.	0.	0.	0.	12132.	270007.	20727.	3297.
	2	0.	0.	0.	0.	12e28.	672e21.	19308.	3108.
	3	0.	0.	0.	0.	12e89.	283385.	23e93.	4702.
	4	0.	0.	0.	0.	14e41.	580936.	22108.	5e39.
	5	0.	0.	0.	0.	9e03.	5e7e81.	44e92.	12e7.
10									
	1	0.	0.	0.	0.	12132.	270007.	20727.	3297.
	2	0.	0.	0.	0.	12e28.	672e21.	19308.	3108.
	3	0.	0.	0.	0.	12e89.	283385.	23e93.	4702.
	4	0.	0.	0.	0.	14e41.	580936.	22108.	5e39.
	5	0.	0.	0.	0.	9e03.	5e7e81.	44e92.	12e7.
11									
	1	0.	0.	0.	0.	12132.	270007.	20727.	3297.
	2	0.	0.	0.	0.	12e28.	672e21.	19308.	3108.
	3	0.	0.	0.	0.	12e89.	283385.	23e93.	4702.
	4	0.	0.	0.	0.	14e41.	580936.	22108.	5e39.
	5	0.	0.	0.	0.	9e03.	5e7e81.	44e92.	12e7.
12									
	1	0.	0.	0.	0.	12132.	270007.	20727.	3297.
	2	0.	0.	0.	0.	12e28.	672e21.	19308.	3108.
	3	0.	0.	0.	0.	12e89.	283385.	23e93.	4702.
	4	0.	0.	0.	0.	14e41.	580936.	22108.	5e39.
	5	0.	0.	0.	0.	9e03.	5e7e81.	44e92.	12e7.
13									
	1	0.	0.	0.	0.	12132.	270007.	20727.	3297.
	2	0.	0.	0.	0.	12e28.	672e21.	19308.	3108.
	3	0.	0.	0.	0.	12e89.	283385.	23e93.	4702.
	4	0.	0.	0.	0.	14e41.	580936.	22108.	5e39.
	5	0.	0.	0.	0.	9e03.	5e7e81.	44e92.	12e7.

CASE 5 (continued)

LIFE CYCLE YEAR	COMPONENT	DIFFERENTIAL COST IN APPLICABLE YEAR							
		D-IR	IR	RD	IN	RPC	PCC	TC	OMC
1									
	1	0.	0.	0.	0.	0.	0.	0.	0.
	2	0.	0.	239514.	0.	0.	0.	0.	0.
	3	0.	0.	239514.	0.	0.	0.	0.	0.
	4	0.	0.	278565.	0.	0.	0.	0.	0.
	5	0.	0	0.	0.	0.	0.	0.	0.
2									
	1	0.	0.	0.	0.	0.	0.	0.	0.
	2	0.	0.	239514.	0.	0.	0.	0.	0.
	3	0.	0.	239514.	0.	0.	0.	0.	0.
	4	0.	0.	278565.	0.	0.	0.	0.	0.
	5	0.	0.	0.	0.	0.	0.	0.	0.
3									
	1	0.	1752e0.	0.	0.	0.	0.	0.	0.
	2	201834.	2737134.	0.	0.	0.	0.	0.	0.
	3	403934.	359176.	0.	13.	0.	0.	0.	0.
	4	605960.	2179894.	0.	19.	0.	0.	0.	0.
	5	201834.	0.	0.	0.	0.	0.	0.	0.
4									
	1	0.	1752e0.	0.	0.	2529.	0.	1419.	2090.
	2	201834.	2737134.	0.	0.	2825.	402414.	0.	1902.
	3	403934.	359176.	0.	13.	2885.	13378.	4385.	3498.
	4	605960.	2179894.	0.	19.	9038.	310929.	2800.	4233.
	5	201834.	0.	0.	0.	0.	297674.	25384.	0.
5									
	1	0.	1752e0.	0.	0.	2529.	0.	1419.	2090.
	2	201834.	2737134.	0.	0.	2825.	402414.	0.	1902.
	3	403934.	359176.	0.	13.	2885.	13378.	4385.	3498.
	4	605960.	2179894.	0.	19.	9038.	310929.	2800.	4233.
	5	201834.	0.	0.	0.	0.	297674.	25384.	0.
6									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	402414.	0.	1902.
	3	0.	0.	0.	0.	2885.	13378.	4385.	3498.
	4	0.	0.	0.	0.	9038.	310929.	2800.	4233
	5	0.	0.	0.	0.	0.	297674.	25384.	0.
7									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	402414.	0.	1902.
	3	0.	0.	0.	0.	2885.	13378.	4385.	3498.
	4	0.	0.	0.	0.	9038.	310929.	2800.	4233.
	5	0.	0.	0.	0.	0.	297674.	25384.	0.
8									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	402414.	0.	1902.
	3	0.	0.	0.	0.	2885.	13378.	4385.	3498.
	4	0.	0.	0.	0.	9038.	310929.	2800.	4233.
	5	0.	0.	0.	0.	0.	297674.	25384.	0.
9									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	402414.	0.	1902.
	3	0.	0.	0.	0.	2885.	13378.	4385.	3498.
	4	0.	0.	0.	0.	9038.	310929.	2800.	4233.
	5	0.	0.	0.	0.	0.	297674.	25384.	0.
10									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	402414.	0.	1902.
	3	0.	0.	0.	0.	2885.	13378.	4385.	3498.
	4	0.	0.	0.	0.	9038.	310929.	2800.	4233.
	5	0.	0.	0.	0.	0.	297674.	25384.	0.
11									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	402414.	0.	1902.
	3	0.	0.	0.	0.	2885.	13378.	4385.	3498.
	4	0.	0.	0.	0.	9038.	310929.	2800.	4233.
	5	0.	0.	0.	0.	0.	297674.	25384.	0.
12									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	402414.	0.	1902.
	3	0.	0.	0.	0.	2885.	13378.	4385.	3498.
	4	0.	0.	0.	0.	9038.	310929.	2800.	4233.
	5	0.	0.	0.	0.	0.	297674.	25384.	0.
13									
	1	0.	0.	0.	0.	2529.	0.	1419.	2090.
	2	0.	0.	0.	0.	2825.	402414.	0.	1902.
	3	0.	0.	0.	0.	2885.	13378.	4385.	3498.
	4	0.	0.	0.	0.	9038.	310929.	2800.	4233.
	5	0.	0.	0.	0.	0.	297674.	25384.	0.

CASE 8 (continued)

LIFE CYCLE YEAR	DISCOUNT RATE AT.10	COMPONENT	DISCOUNTED DIFFERENTIAL COST IN APPLICABLE YEAR							
			O-IR	IR	RC	IN	RPC	PCC	TC	DMC
1	1.000									
		1	0.	0.	0.	0.	0.	0.	0.	0.
		2	0.	0.	219514.	0.	0.	0.	0.	0.
		3	0.	0.	239514.	0.	0.	0.	0.	0.
		4	0.	0.	278959.	0.	0.	0.	0.	0.
		5	0.	0.	0.	0.	0.	0.	0.	0.
2	0.909									
		1	0.	0.	0.	0.	0.	0.	0.	0.
		2	0.	0.	217743.	0.	0.	0.	0.	0.
		3	0.	0.	217740.	0.	0.	0.	0.	0.
		4	0.	0.	253180.	0.	0.	0.	0.	0.
		5	0.	0.	0.	0.	0.	0.	0.	0.
3	0.826									
		1	0.	1448+8.	0.	0.	0.	0.	0.	0.
		2	1008+5.	22a209+.	0.	5.	0.	0.	0.	0.
		3	333829.	2968+3.	0.	11.	0.	0.	0.	0.
		4	70797.	1801569.	0.	16.	0.	0.	0.	0.
		5	1008+9.	0.	0.	5.	0.	0.	0.	0.
4	0.751									
		1	0.	131680.	0.	0.	1900.	0.	1066.	1570.
		2	151e+1.	205e449.	0.	5.	2122.	102339.	0.	1429.
		3	333+41.	2e985+.	0.	10.	2168.	10091.	3295.	2e26.
		4	+55270.	1e37787.	0.	15.	3785.	238e05.	2103.	3180.
		5	151e+1.	0.	0.	5.	0.	223647.	19072.	0.
5	0.683									
		1	0.	119709.	0.	0.	1727.	0.	969.	1428.
		2	137858.	18e9+99.	0.	4.	1929.	274834.	0.	1499.
		3	275892.	245322.	0.	9.	1971.	9137.	2995.	2388.
		4	+13882.	1488897.	0.	13.	3441.	212369.	1912.	2891.
		5	13785e.	0.	0.	4.	0.	203315.	17338.	0.
6	0.621									
		1	0.	0.	0.	0.	1570.	0.	881.	1298.
		2	0.	0.	0.	0.	1754.	249807.	0.	1161.
		3	0.	0.	0.	0.	1792.	8307.	2723.	2171.
		4	0.	0.	0.	0.	3128.	193062.	1738.	2628.
		5	0.	0.	0.	0.	0.	184832.	15762.	0.
7	0.564									
		1	0.	0.	0.	0.	1427.	0.	801.	1180.
		2	0.	0.	0.	0.	1594.	227152.	0.	1073.
		3	0.	0.	0.	0.	1629.	7552.	2475.	1973.
		4	0.	0.	0.	0.	2844.	175511.	1580.	2389.
		5	0.	0.	0.	0.	0.	168029.	14329.	0.
8	0.513									
		1	0.	0.	0.	0.	1298.	0.	723.	1073.
		2	0.	0.	0.	0.	1449.	206502.	0.	976.
		3	0.	0.	0.	0.	1481.	6865.	2250.	1794.
		4	0.	0.	0.	0.	2585.	159558.	1437.	2172.
		5	0.	0.	0.	0.	0.	152754.	13026.	0.
9	0.467									
		1	0.	0.	0.	0.	1180.	0.	662.	975.
		2	0.	0.	0.	0.	1318.	187729.	0.	887.
		3	0.	0.	0.	0.	1346.	6241.	2046.	1631.
		4	0.	0.	0.	0.	2351.	145251.	1306.	1975.
		5	0.	0.	0.	0.	0.	138867.	11842.	0.
10	0.424									
		1	0.	0.	0.	0.	1.72.	0.	602.	886.
		2	0.	0.	0.	0.	1195.	17e863.	0.	806.
		3	0.	0.	0.	0.	1224.	5674.	1860.	1483.
		4	0.	0.	0.	0.	2137.	1318e4.	1187.	1795.
		5	0.	0.	0.	0.	0.	126243.	10765.	0.
11	0.386									
		1	0.	0.	0.	0.	975.	0.	547.	808.
		2	0.	0.	0.	0.	1089.	155148.	0.	733.
		3	0.	0.	0.	0.	1112.	5158.	1691.	1348.
		4	0.	0.	0.	0.	1942.	119677.	1079.	1632.
		5	0.	0.	0.	0.	0.	114766.	9787.	0.
12	0.350									
		1	0.	0.	0.	0.	886.	0.	497.	733.
		2	0.	0.	0.	0.	990.	141044.	0.	666.
		3	0.	0.	0.	0.	1011	4689.	1537.	1225.
		4	0.	0.	0.	0.	1766	108979.	981.	1483.
		5	0.	0.	0.	0.	0.	104333.	8897.	0.
13	0.319									
		1	0.	0.	0.	0.	805.	0.	452.	666.
		2	0.	0.	0.	0.	902.	128271.	0.	606.
		3	0.	0.	0.	0.	919.	4263.	1397.	1114.
		4	0.	0.	0.	0.	1605.	99171.	892.	1349.
		5	0.	0.	0.	0.	0.	94848.	8086.	0.

CASE 5 (continued)

LIFE CYCLE YEAR	TOTAL DISCOUNTED DIFFERENTIAL COST IN APPLICABLE YEAR				
COMPONENT--	1	2	3	4	5
4	0.	239914.	239514.	278503.	0.
5	0.	217743.	217743.	253186.	0.
6	144848.	2428933.	636683.	2302378.	166811.
7	136217.	2513486.	591455.	2335745.	394365.
8	123833.	2289441.	537714.	2123403.	358513.
9	3749.	252802.	14992.	200557.	203594.
10	3408.	229820.	13629.	182325.	182358.
11	3099.	208927.	12393.	165750.	165780.
12	2817.	189934.	11264.	150682.	150709.
13		172667.	10240.	136983.	137008.
14	2566.	156973.	9329.	124530.	124553.
15	2116.	142700.	8463.	113209.	113230.
16	1924.	129727.	7693.	102918.	102936.
TOTAL DISCOUNTED DIFFERENTIAL LIFE CYCLE EFFECTIV. COST INFLUENCE, ECI	426900.	9169133.	2305111.	8470171.	2096857.
SPARES	61	55	63	58	147

CASE 6

LIFE CYCLE YEAR	COMPONENT	ANNUAL COST IN APPLICABLE YEAR							
		D-IR	IR	RD	IN	MPC	PCC	FC	DMC
1									
	1	0.	0.	479028.	0.	0.	0.	0.	0.
	2	0.	0.	718542.	0.	0.	0.	0.	0.
	3	0.	0.	718542.	0.	0.	0.	0.	0.
	4	0.	0.	957933.	0.	0.	0.	0.	0.
	5	0.	0.	479028.	0.	0.	0.	0.	0.
2									
	1	0.	0.	479028.	0.	0.	0.	0.	0.
	2	0.	0.	718542.	0.	0.	0.	0.	0.
	3	0.	0.	718542.	0.	0.	0.	0.	0.
	4	0.	0.	957933.	0.	0.	0.	0.	0.
	5	0.	0.	479028.	0.	0.	0.	0.	0.
3									
	1	-201834.	1189012.	0.	26594.	0.	0.	0.	0.
	2	-0.	3523907.	0.	26600.	0.	0.	0.	0.
	3	201932.	1351943.	0.	26606.	0.	0.	0.	0.
	4	403963.	3017825.	0.	26613.	0.	0.	0.	0.
	5	-0.	1134581.	0.	26600.	0.	0.	0.	0.
4									
	1	-201834.	1189012.	0.	26594.	13328.	271088.	22771.	3622.
	2	-0.	3523907.	0.	26600.	13689.	674749.	21267.	3423.
	3	201932.	1351943.	0.	26606.	13723.	284346.	26029.	5166.
	4	403963.	3017825.	0.	26613.	16106.	582853.	24318.	5983.
	5	-0.	1134581.	0.	26600.	10550.	623650.	49099.	1325.
5									
	1	-201834.	1189012.	0.	26594.	13328.	271088.	22771.	3622.
	2	-0.	3523907.	0.	26600.	13689.	674749.	21267.	3423.
	3	201932.	1351943.	0.	26606.	13720.	284346.	26029.	5166.
	4	403963.	3017825.	0.	26613.	16106.	582853.	24318.	5983.
	5	-0.	1134581.	0.	26600.	10550.	623650.	49099.	1325.
6									
	1	0.	0.	0.	0.	13328.	271088.	22771.	3622.
	2	0.	0.	0.	0.	13689.	674749.	21267.	3423.
	3	0.	0.	0.	0.	13720.	284346.	26029.	5166.
	4	0.	0.	0.	0.	16106.	582853.	24318.	5983.
	5	0.	0.	0.	0.	10550.	623650.	49099.	1325.
7									
	1	0.	0.	0.	0.	13328.	271088.	22771.	3622.
	2	0.	0.	0.	0.	13689.	674749.	21267.	3423.
	3	0.	0.	0.	0.	13720.	284346.	26029.	5166.
	4	0.	0.	0.	0.	16106.	582853.	24318.	5983.
	5	0.	0.	0.	0.	10550.	623650.	49099.	1325.
8									
	1	0.	0.	0.	0.	13328.	271088.	22771.	3622.
	2	0.	0.	0.	0.	13689.	674749.	21267.	3423.
	3	0.	0.	0.	0.	13720.	284346.	26029.	5166.
	4	0.	0.	0.	0.	16106.	582853.	24318.	5983.
	5	0.	0.	0.	0.	10550.	623650.	49099.	1325.
9									
	1	0.	0.	0.	0.	13328.	271088.	22771.	3622.
	2	0.	0.	0.	0.	13689.	674749.	21267.	3423.
	3	0.	0.	0.	0.	13720.	284346.	26029.	5166.
	4	0.	0.	0.	0.	16106.	582853.	24318.	5983.
	5	0.	0.	0.	0.	10550.	623650.	49099.	1325.
10									
	1	0.	0.	0.	0.	13328.	271088.	22771.	3622.
	2	0.	0.	0.	0.	13689.	674749.	21267.	3423.
	3	0.	0.	0.	0.	13720.	284346.	26029.	5166.
	4	0.	0.	0.	0.	16106.	582853.	24318.	5983.
	5	0.	0.	0.	0.	10550.	623650.	49099.	1325.
11									
	1	0.	0.		0.	13328.	271088.	22771.	3622.
	2	0.	0.		0.	13689.	674749.	21267.	3423.
	3	0.	0.	0	0.	13720.	284346.	26029.	5166.
	4	0.	0.	0.	0.	16106.	582853.	24318.	5983.
	5	0.	0.	0.	0.	10550.	623650.	49099.	1325.
12									
	1	0.	0.	0.	0.	13328.	271088.	22771.	3622.
	2	0.	0.	0.	0.	13689.	674749.	21267.	3423.
	3	0.	0.	0.	0.	13720.	284346.	26029.	5166.
	4	0.	0.	0.	0.	16106.	582853.	24318.	5983.
	5	0.	0.	0.	0.	10550.	623650.	49099.	1325.
13									
	1	0.	0.	0.	0.	13328.	271088.	22771.	3622.
	2	0.	0.	0.	0.	13689.	674749.	21267.	3423.
	3	0.	0.	0.	0.	13720.	284346.	26029.	5166.
	4	0.	0.	0.	0.	16106.	582853.	24318.	5983.
	5	0.	0.	0.	0.	10550.	623650.	49099.	1325.

CASE 6 (continued)

LIFE CYCLE YEAR	COMPONENT	DIFFERENTIAL COST IN APPLICABLE YEAR							
		D-IR	IR	RD	IN	MPC	PCC	TC	DRC
1									
	1	0.	0.	0.	0.	0.	0.	0.	0.
	2	0.	0.	239514.	0.	0.	0.	0.	0.
	3	0.	0.	239514.	0.	0.	0.	0.	0.
	4	0.	0.	278509.	0.	0.	0.	0.	0.
	5	0.	0.	0.	0.	0.	0.	0.	0.
2									
	1	0.	0.	0.	0.	0.	0.	0.	0.
	2	0.	0.	239514.	0.	0.	0.	0.	0.
	3	0.	0.	239514.	0.	0.	0.	0.	0.
	4	0.	0.	278509.	0.	0.	0.	0.	0.
	5	0.	0.	0.	0.	0.	0.	0.	0.
3									
	1	0.	50430.	0.	0.	0.	0.	0.	0.
	2	201834.	2389325.	0.	0.	0.	0.	0.	0.
	3	403767.	217362.	0.	13.	0.	0.	0.	0.
	4	605797.	1883243.	0.	19.	0.	0.	0.	0.
	5	201834.	0.	0.	6.	0.	0.	0.	0.
4									
	1	0.	50430.	0.	0.	2778.	0.	1504.	2298.
	2	201834.	2389325.	0.	6.	3139.	403661.	0.	2098.
	3	403767.	217362.	0.	13.	3170.	13258.	4762.	3840.
	4	605797.	1883243.	0.	19.	5556.	311765.	3052.	4658.
	5	201834.	0.	0.	6.	0.	352562.	27832.	0.
5									
	1	0.	50430.	0.	0.	2778.	0.	1504.	2298.
	2	201834.	2389325.	0.	6.	3139.	403661.	0.	2098.
	3	403767.	217362.	0.	13.	3170.	13258.	4762.	3840.
	4	605797.	1883243.	0.	19.	5556.	311765.	3052.	4658.
	5	201834.	0.	0.	6.	0.	352562.	27832.	0.
6									
	1	0.	0.	0.	0.	2778.	0.	1504.	2298.
	2	0.	0.	0.	0.	3139.	403661.	0.	2098.
	3	0.	0.	0.	0.	3170.	13258.	4762.	3840.
	4	0.	0.	0.	0.	5556.	311765.	3052.	4658.
	5	0.	0.	0.	0.	0.	352562.	27832.	0.
7									
	1	0.	0.	0.	0.	2778.	0.	1504.	2298.
	2	0.	0.	0.	0.	3139.	403661.	0.	2098.
	3	0.	0.	0.	0.	3170.	13258.	4762.	3840.
	4	0.	0.	0.	0.	5556.	311765.	3052.	4658.
	5	0.	0.	0.	0.	0.	352562.	27832.	0.
8									
	1	0.	0.	0.	0.	2778.	0.	1504.	2298.
	2	0.	0.	0.	0.	3139.	403661.	0.	2098.
	3	0.	0.	0.	0.	3170.	13258.	4762.	3840.
	4	0.	0.	0.	0.	5556.	311765.	3052.	4658.
	5	0.	0.	0.	0.	0.	352562.	27832.	0.
9									
	1	0.	0.	0.	0.	2778.	0.	1504.	2298.
	2	0.	0.	0.	0.	3139.	403661.	0.	2098.
	3	0.	0.	0.	0.	3170.	13258.	4762.	3840.
	4	0.	0.	0.	0.	5556.	311765.	3052.	4658.
	5	0.	0.	0.	0.	0.	352562.	27832.	0.
10									
	1	0.	0.	0.	0.	2778.	0.	1504.	2298.
	2	0.	0.	0.	0.	3139.	403661.	0.	2098.
	3	0.	0.	0.	0.	3170.	13258.	4762.	3840.
	4	0.	0.	0.	0.	5556.	311765.	3052.	4658.
	5	0.	0.	0.	0.	0.	352562.	27832.	0.
11									
	1	0.	0.	0.	0.	2778.	0.	1504.	2298.
	2	0.	0.	0.	0.	3139.	403661.	0.	2098.
	3	0.	0.	0.	0.	3170.	13258.	4762.	3840.
	4	0.	0.	0.	0.	5556.	311765.	3052.	4658.
	5	0.	0.	0.	0.	0.	352562.	27832.	0.
12									
	1	0.	0.	0.	0.	2778.	0.	1504.	2298.
	2	0.	0.	0.	0.	3139.	403661.	0.	2098.
	3	0.	0.	0.	0.	3170.	13258.	4762.	3840.
	4	0.	0.	0.	0.	5556.	311765.	3052.	4658.
	5	0.	0.	0.	0.	0.	352562.	27832.	0.
13									
	1	0.	0.	0.	0.	2778.	0.	1504.	2298.
	2	0.	0.	0.	0.	3139.	403661.	0.	2098.
	3	0.	0.	0.	0.	3170.	13258.	4762.	3840.
	4	0.	0.	0.	0.	5556.	311765.	3052.	4658.
	5	0.	0.	0.	0.	0.	352562.	27832.	0.

CASE 6 (continued)

LIFE CYCLE YEAR	DISCOUNT RATE AT.10	COMPONENT	DISCOUNTED DIFFERENTIAL COST IN APPLICABLE YEAR						
			O-IR	IR	RO	IN	MPC	PCC	TC	OMC
1	1.000									
		1	0.	0.	0.	0.	0.	0.	0.	0.
		2	0.	0.	239514.	0.	0.	0.	0.	0.
		3	0.	0.	239514.	0.	0.	0.	0.	0.
		4	0.	0.	276905.	0.	0.	0.	0.	0.
		5	0.	0.	0.	0.	0.	0.	0.	0.
2	0.909									
		1	0.	0.	0.	0.	0.	0.	0.	0.
		2	0.	0.	217740.	0.	0.	0.	0.	0.
		3	0.	0.	217740.	0.	0.	0.	0.	0.
		4	0.	0.	251186.	0.	0.	0.	0.	0.
		5	0.	0.	0.	0.	0.	0.	0.	0.
3	0.826									
		1	0.	41678.	0.	0.	0.	0.	0.	0.
		2	166805.	1974849.	0.	5.	0.	0.	0.	0.
		3	333692.	179638.	0.	11.	0.	0.	0.	0.
		4	500639.	1556399.	0.	16.	0.	0.	0.	0.
		5	166805.	0.	0.	5.	0.	0.	0.	0.
4	0.751									
		1	0.	37889.	0.	0.	2087.	0.	1130.	1725.
		2	151641.	1795135.	0.	5.	2358.	303277.	0.	1576.
		3	303350.	1633197.	0.	10.	2382.	9961.	3578.	2485.
		4	455144.	1414909.	0.	15.	4174.	214234.	2293.	3498.
		5	151641.	0.	0.	5.	0.	264885.	20910.	0.
5	0.683									
		1	0.	34445.	0.	0.	1897.	0.	1027.	1568.
		2	137856.	1631941.	0.	5.	2144.	275796.	0.	1433.
		3	275778.	1484461.	0.	9.	2165.	9055.	3253.	2623.
		4	413768.	1286280.	0.	13.	3795.	212940.	2084.	3181.
		5	137856.	0.	0.	4.	0.	240805.	19010.	0.
6	0.621									
		1	0.	0.	0.	0.	1725.	0.	934.	1426.
		2	0.	0.	0.	0.	1949.	250642.	0.	1303.
		3	0.	0.	0.	0.	1968.	8232.	2957.	2385.
		4	0.	0.	0.	0.	3450.	193582.	1895.	2892.
		5	0.	0.	0.	0.	0.	218913.	17281.	0.
7	0.564									
		1	0.	0.	0.	0.	1568.	0.	849.	1296.
		2	0.	0.	0.	0.	1772.	227859.	0.	1184.
		3	0.	0.	0.	0.	1789.	7484.	2688.	2168.
		4	0.	0.	0.	0.	3136.	175983.	1723.	2629.
		5	0.	0.	0.	0.	0.	199012.	15710.	0.
8	0.513									
		1	0.	0.	0.	0.	1426.	0.	772.	1178.
		2	0.	0.	0.	0.	1611.	207142.	0.	1077.
		3	0.	0.	0.	0.	1627.	6803.	2444.	1971.
		4	0.	0.	0.	0.	2851.	159985.	1566.	2390.
		5	0.	0.	0.	0.	0.	180920.	14287.	0.
9	0.467									
		1	0.	0.	0.	0.	1296.	0.	702.	1071.
		2	0.	0.	0.	0.	1464.	188311.	0.	979.
		3	0.	0.	0.	0.	1479.	6185.	2222.	1792.
		4	0.	0.	0.	0.	2592.	145441.	1424.	2173.
		5	0.	0.	0.	0.	0.	164473.	12984.	0.
10	0.424									
		1	0.	0.	0.	0.	1178.	0.	638.	974.
		2	0.	0.	0.	0.	1331.	171192.	0.	890.
		3	0.	0.	0.	0.	1344.	5623.	2020.	1629.
		4	0.	0.	0.	0.	2356.	132219.	1294.	1975.
		5	0.	0.	0.	0.	0.	149521.	11803.	0.
11	0.386									
		1	0.	0.	0.	0.	1071.	0.	580.	885.
		2	0.	0.	0.	0.	1210.	155629.	0.	809.
		3	0.	0.	0.	0.	1222.	5112.	1836.	1481.
		4	0.	0.	0.	0.	2142.	120198.	1177.	1796.
		5	0.	0.	0.	0	0.	135928.	10730.	0.
12	0.350									
		1	0.	0.	0.	0.	974.	0.	527.	805.
		2	0.	0.	0.	0.	1100.	141481.	0.	735.
		3	0.	0.	0.	0.	1111.	4647.	1669.	1346.
		4	0.	0.	0.	0.	1947.	109272.	1070.	1632.
		5	0.	0.	0.	0.	0.	123571.	9755.	0.
13	0.319									
		1	0.	0.	0.	0.	885.	0.	479.	732.
		2	0.	0.	0.	0.	1000.	128619.	0.	668.
		3	0.	0.	0.	0.	1010.	4224.	1517.	1224.
		4	0.	0.	0.	0.	1770.	99336.	972.	1484.
		5	0.	0.	0.	0.	0.	112337.	8868.	0.

CASE 6 (continued)

LIFE CYCLE YEAR	TOTAL DISCOUNTED DIFFERENTIAL COST IN APPLICABLE YEAR				
COMPONENT--	1	2	3	4	5
1	0.	239514.	239514.	278505.	0.
2	0.	217740.	217740.	253186.	0.
3	41678.	2141460.	513343.	2057074.	166811.
4	42831.	2253993.	485479.	2114267.	437442.
5	38938.	2049384.	441344.	1922061.	397674.
6	4085.	253893.	15542.	201818.	236195.
7	3713.	230812.	14129.	183471.	214722.
8	3376.	209829.	12845.	166792.	195202.
9	3069.	190754.	11677.	151629.	177457.
10	2790.	173413.	10615.	137844.	161324.
11	2536.	157648.	9650.	125313.	146658.
12	2306.	143316.	8773.	113921.	133326.
13	2096.	130287.	7976.	103565.	121205.
TOTAL DISCOUNTED DIFFERENTIAL LIFE CYCLE EFFECTIVE COST INFLUENCE, ECI	147418.	8391743.	1988625.	7809446.	2388016.
SPARES	67	60	68	64	161